OCTOBER 1960 / 50¢

AIR FORCE

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and SPACE DIGEST

The Magazine of Aerospace Power / Published by the Air Force Association

OHIO STATE UNIVERSITY
OCT - 6 1960
LIBR... Y

higher...
faster...
X-15

the first step into space is the walk to the cockpit

SEE PAGE 42

OFFICE OF THE PRESIDENT • THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONN.

MEMO TO JOHN:

Thank you for your letter in which you express your preference for Kaman helicopters. As you put it:

YOUR
TRRffIC IN HEIICOPTERS. That is the truth. It sure is ~~the~~ the truth.

Everyone here at Kaman Aircraft is proud of the helicopters and aircraft we build and supply to various branches of our Armed Forces. It makes us doubly proud when boys like you write and tell us what you think. We know that you realize that our whole National Defense program is one sure way of guaranteeing that you and your friends will get the chance to grow up and become terrific doctors or lawyers or scientists... maybe even terrific helicopter pilots.

Sincerely,

Charles H Kaman

...in National Defense KAMAN is part of the plan

**Factsimile of a letter to the company

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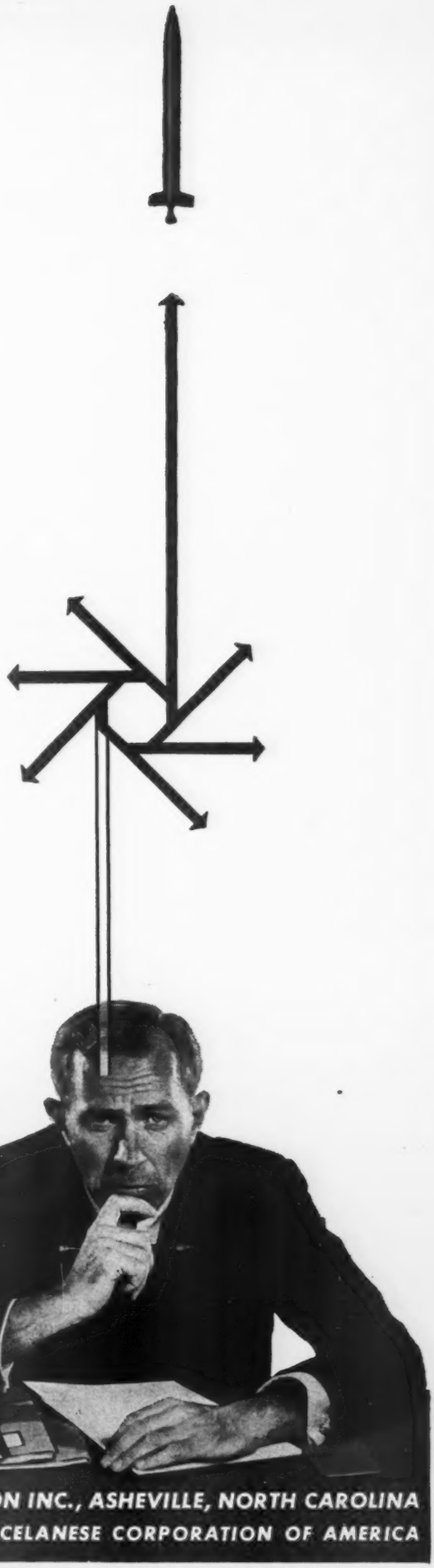

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To solve the plane's extraordinary operational requirements, Hamilton Standard is developing the most advanced and comprehensive environment conditioning system ever planned for an aircraft. It will provide completely automatic...

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- moisture removal
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MAIN COOLING for crew and avionic compartments is provided by a closed vapor-cycle/air recirculation system and several closed-loop transport systems.

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DIVISION OF UNITED AIRCRAFT CORPORATION

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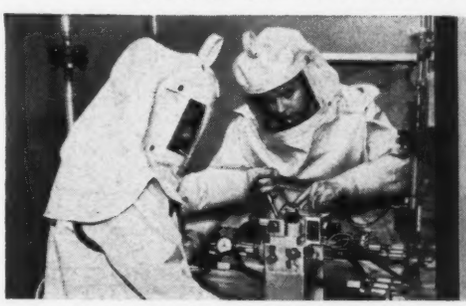
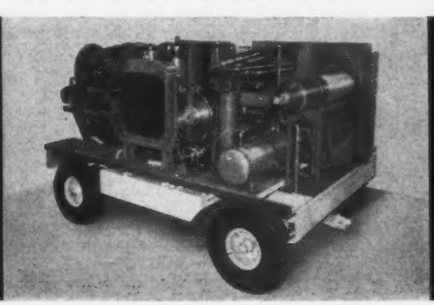
SOME OF THE MANY FIELDS OF GROWTH AT HAMILTON STANDARD



ENGINE CONTROLS for over 20,000 aircraft gas turbines have been produced by Hamilton Standard. The company's latest control work involves advanced rocket engines.



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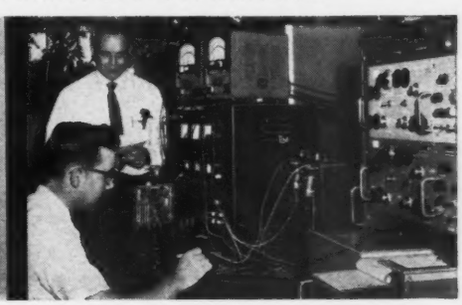

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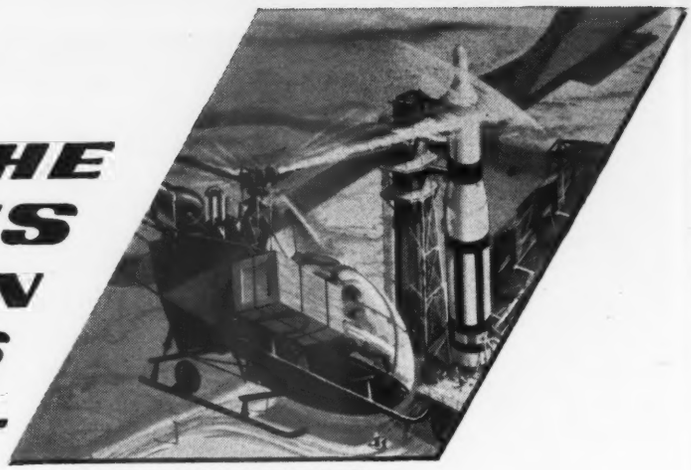

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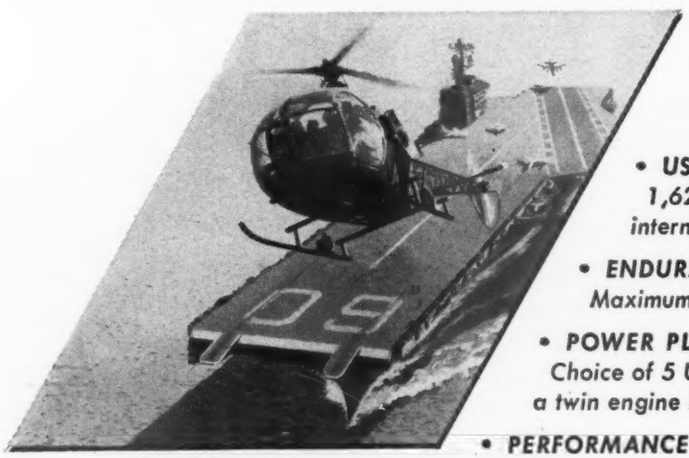

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FARMINGDALE, LONG ISLAND, N. Y.

AIR FORCE

and **SPACE DIGEST**

The Magazine of Aerospace Power / *Published by the Air Force Association*

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An Editorial

Minimum Deterrence Is a Phony

John F. Loosbrock, Editor

MANY centuries ago, before historians began to record events for future study, there were two tribes. One tribe loved peace. It had no aggressive designs on the hunting grounds of any of its neighbors. It possessed such skill in contriving weapons and in using them that it was never attacked for fear of the consequences to the attacker. This went on for years.

But at last the security of the peace-loving tribe was challenged. A nearby tribe, more numerous and more warlike, became ambitious. It conquered several of its weaker neighbors and began to cast covetous eyes on the territory and possessions of the peaceful tribe. In the beginning, however, it dared not attack because the superior weapons of the peaceful tribe held the aggressor tribe at bay. The aggressor bided his time, however, and concentrated on building more and better weapons, and on training warriors in their use.

The peaceful tribe built more weapons, too, but, because it was very busy at other things, it did not try to match the aggressor tribe man for man or weapon for weapon.

"After all," its leaders said, "we have enough weapons to kill a good many of them if they attack us. They know that, even if we cannot lick their army, we can sneak around behind them, lay waste their villages and kill their women and children. The fear of this will keep them from attacking."

What actually happened was this: The aggressors grew so strong that they decided they were ready to whip the peace-lovers' army. So they issued an ultimatum—"Lay down your arms or we will lick your army. In either case, we're taking over."

How the peaceful tribe reacted has not come down to us. Obviously it was in a terrible fix. If it decided to fight it would get licked, because its army was not strong enough to win a war. True, the survivors, plus a few scouts who were on patrol and not mixed up in the main battle, could always sneak around and burn a few villages and kill a few women and children. But the tribe with the best army would still have won. And it could then do as it pleased with the villages and the women and children of the losers. Scattered survivors of the losing army might fight on but it would not mean much if there was no nation to come home to.

The moral is that you can't deter a war by threatening to kill the enemy's women and children. You have to be strong enough to lick his military forces.

* * *

This is a fable, obviously, but a fable for our times. It represents the two conflicting theories of deterrence that are currently struggling for ascendancy in the strategic planning of the United States. One school of thought holds that we must have strategic forces able to absorb a blow and still whip the forces of the Communist bloc should they ever decide to challenge us or our allies. It further holds that having such forces is the best assurance that an attack will never come. This is the counterforce theory of deterrence and, for our money, the only one that makes sense.

The other school of thought says that we don't have to be able to whip the Communist forces. All we need, these people say, is to have enough strength left over after an attack so that we can burn a number of Soviet cities and kill several million Soviet citizens, be they men, women, or children. This is the counter-population concept of deterrence, otherwise known as "minimum" or "finite" deterrence.

The proponents of minimum deterrence put great emphasis on making the deterrent force invulnerable, primarily through mobility. They go so far as to say that, if we deploy the bulk of our mobile deterrent forces outside of the United States, we need never fear an attack on this country.

The attractions of this minimum deterrence theory are obvious.

First, it involves spending less money than it does to prepare to win a war.

Second, it holds out the hope that the United States itself need never suffer damage and therefore need not prepare to cut down damage through civil defense and other measures.

In fact, there is only one big objection to the concept. That objection is that minimum deterrence is as phony as the proverbial three-dollar bill. It is minimal, all right, but it doesn't deter.

It will not deter a general war because it does not pose to the enemy a believable threat of defeat.

It will not deter limited war because it removes the protective strategic umbrella from free-world limited-war forces.

It writes off our commitments to our allies, for who can conceive of the United States committing her deterrent force in defense of Western Europe if by so doing we invite the destruction of our own country?

If this nation accepts the doctrine of minimum deterrence as national policy, we will eventually be unable to react to Soviet aggression, no matter what the provocation. It will be tantamount to breaking our solemn obligations to our allies and to signing a nonaggression pact with the Soviet Union—a pact with almost 200,000,000 Americans as hostages.

Minimum deterrence is a cheap and easy answer to an expensive and complicated problem. To follow it is to take the nation down a blind trail to inevitable disaster.—END

LFE

is experienced... in Ground Support Equipment

Before this familiar signal can be given, the intricate electronic circuits of an airborne weapon system must be thoroughly checked.

For 15 years, LFE has devoted extensive research to the development of advanced microwave test equipment for Ground Support. The results have made available many designs that solve difficult and complex radio-frequency measuring problems. Some of these designs are now being used in highly-advanced Ground Support Equipment such as LFE's AN/GPM-24. This self-contained portable tester for airborne doppler navigation equipment is one of the GSE items in quantity production at LFE.

We invite inquiries concerning radio frequency measuring problems for which no pat solution exists.

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SYSTEMS, EQUIPMENT & COMPONENTS FOR AIRBORNE NAVIGATION · RADAR and SURVEILLANCE
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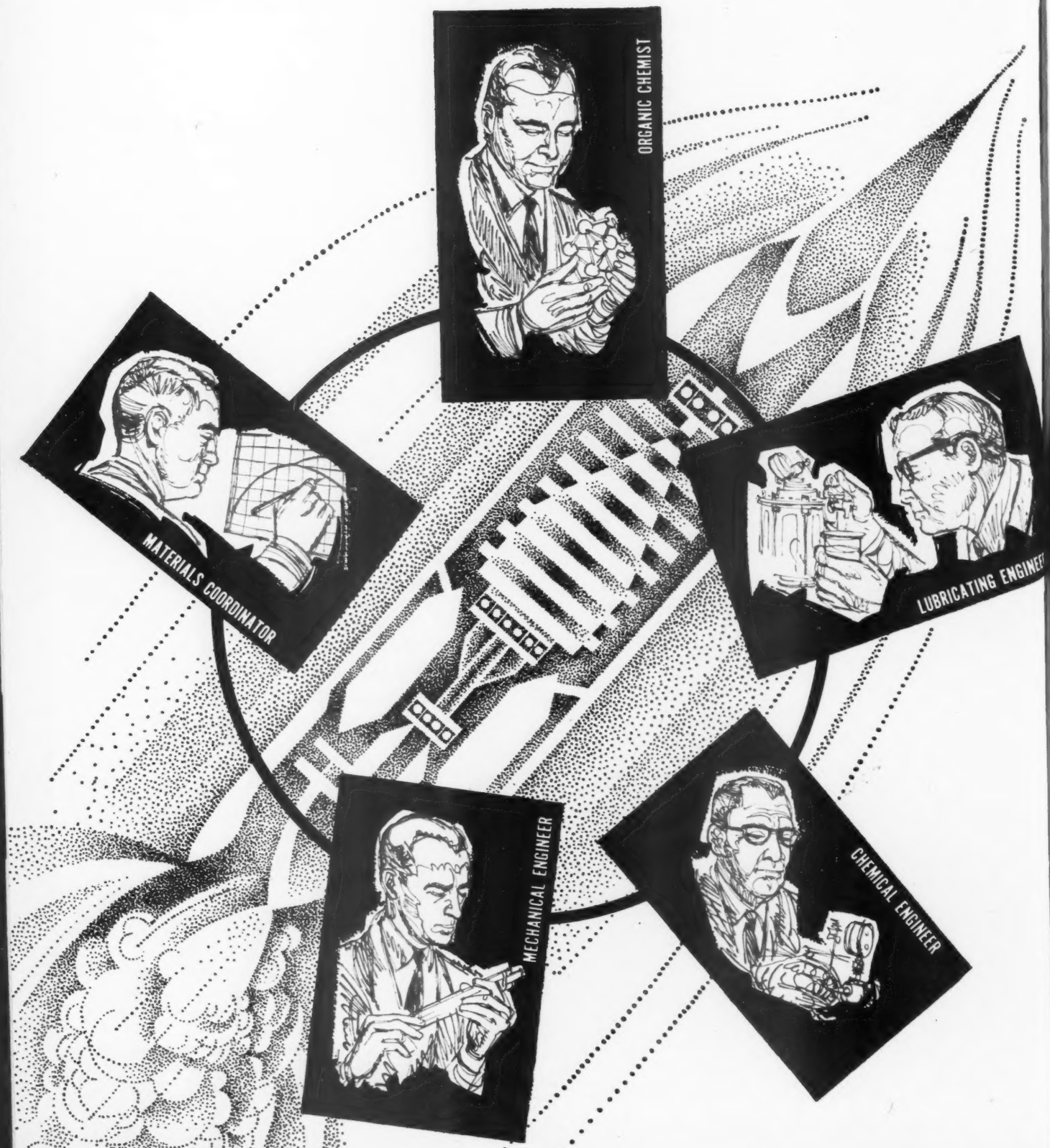
Monsanto

Space-Age Project "HIGH-TEMP-LUBE"

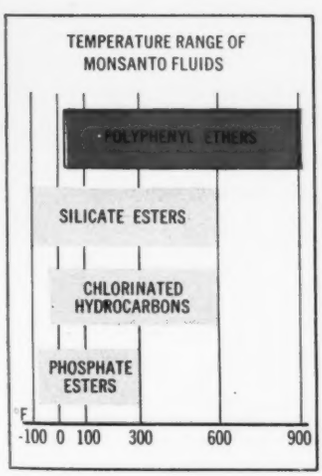
A CHEMICAL EXPEDITION



.....seeking high-temperature lubricants for advanced jets and missiles...discovering new fluids that operate up to 900°F.

Monsanto has established a base of "know-how" in a new area of synthetic fluids: the polyphenyl ethers, fluids that exceed the high-temperature performance of all other known lubricants and hydraulic fluids. These newly synthesized liquids resist radiation damage, oxidation and chemical decomposition: as liquids they cover a temperature range of 20° F. to 900° F. Polyphenyl ethers are the result of creative chemistry applied to the problem of high-temperature lubricants; they were developed under contract and in cooperation with Wright Air Development Division, U. S. Air Force.

The heat stability of Monsanto's polyphenyl ethers is the result of enlisting chemical know-how on a problem of mechanical engineering. By design, lubricants for jet engines (and liquid fuel missiles) must lubricate and cool the bearings and accessory drive gears. Existing lubricants could not meet the requirements of advanced engine design. So the logical step was a Monsanto expedition into little-known fields of chemistry. A team of Monsanto scientists found and developed the polyphenyl ethers: to date, nineteen new compositions of matter.



In comparison with other synthetics, these lubricants are as thermally stable at 840° F., as are silicones and petroleum hydrocarbons at 740° F., and present commercial diesters at 540° F. Their useful temperature range exceeds all other fluids by 100° to 400° F.

Their chemical stability, physical properties, and lubricity recommend them for a host of other fluid applications: "hot" hydraulic systems; base stocks for high-temperature and/or radiation-resistant greases; and heat-transfer fluids.

Until development of the polyphenyl ethers, the calculated* useful life of the *best* synthetic lubricant was a scant 18 minutes at 900° F. Presently used synthetic lubricants would be effective for only 6 seconds to 3 minutes at this temperature. Polyphenyl ethers, however, would have useful lives of *20-80 hours* at 900° F.

*Based on the activation energy derived from isoteniscope data.

THERMAL STABILITY OF POLYPHENYL ETHERS VERSUS OTHER SYNTHETIC LUBRICANTS

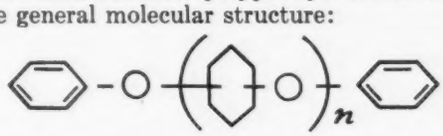
Compound	Decomposition Point, °F.	Useful Life at 900° F.*
Bis (p-phenoxyphenyl) ether	824	25 hours
m-Bis (m-phenoxyphenoxy) benzene	862	80 hours
Bis-p (m-phenoxyphenoxy) phenyl ether	832	20 hours
Quaterphenyl	826	30 hours
Silicone	740	18 minutes
n-Octacosane	662	3 minutes
Tetra (2-ethylhexyl) silicate	638	14.4 seconds
Pentaerythritol tetrahexanoate	585	7.2 seconds
Bis (2-ethylhexyl) sebacate	525	7.2 seconds

**Time to decompose 10%*

Heat stability is one important facet of these new molecules. The polyphenyl ethers also match the lubricity and viscosity indexes of other good lubricants and possess better hydrolytic stability. They are two to five times more stable than most other synthetic fluids under nuclear radiation.

THE PROPERTIES OF THE MOLECULES

The unsubstituted polyphenyl ethers have the general molecular structure:



The "*n*" values range from 1 to 8, each with linkages in various combinations of the *ortho*, *meta* and *para* positions. The various isomeric polyphenyl ethers are all good lubricants: they show heat stability within a narrow range (the 7-ring ether decomposes only 20° F. higher than the 4-ring ether; a 5-ring appears to have the optimum thermal stability).

Varying the chain length does not materially affect lubricity or heat stability—as chain length increases so does pourpoint, and, conversely, volatility decreases. A 7-ring *meta* ether boils at 1150° F., has a pourpoint of 70° F. Chemically "tailoring" and blending can provide optimum lubricant properties.

While the properties of these fluids may solve many needs, the chemical expedition which found them set out to answer the specific problem of advanced turbojet engine and accessory lubrication. Turbine bearings, surrounded by hot gases, must be kept clean, cool and smooth-spinning. (*Please turn page.*)

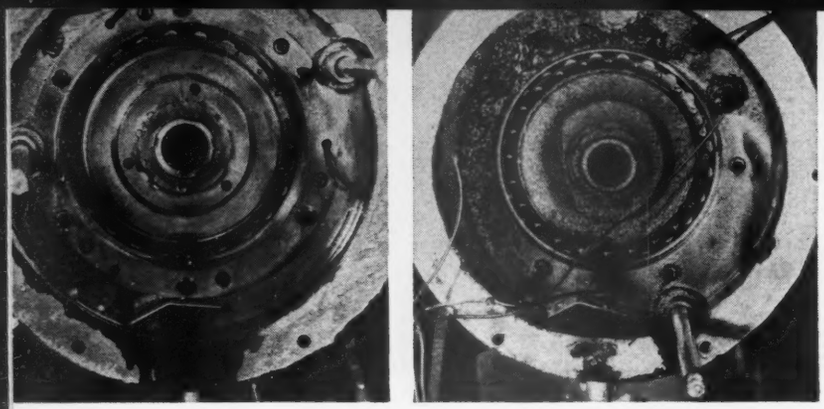
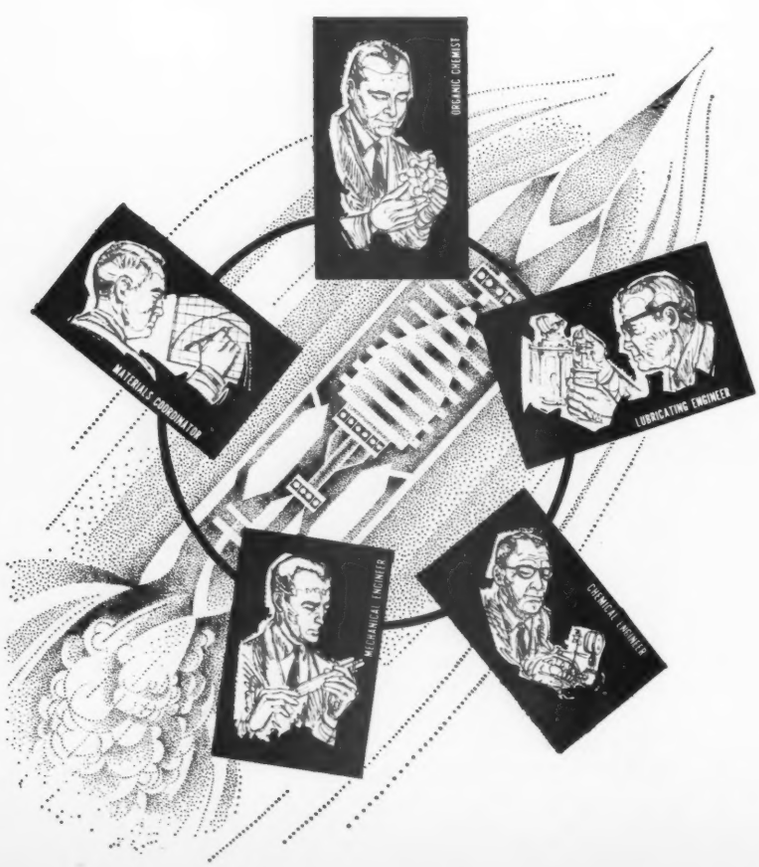


Photo Courtesy Pratt & Whitney Aircraft

Test rig parts for evaluating thermal and oxidative stability and lubrication properties of jet engine lubricants show how a polyphenyl ether (left) leaves the rig parts clean, free of deposits, and with no evidence of wear. Photo at right shows deposits and general condition of parts using one of the best synthetic lubricants prior to development of polyphenyl ethers. Both tests were run at a bearing temperature of 500° F. for 100 hours at a speed of 10,000 RPM.

Between Mach 3 and Mach 4, the skin temperature of craft in sustained flight at 40,000 feet can rise to 900° F., the temperature where steel glows red. In the lubricant reservoir, the polyphenyl ethers withstand this stress. Consequently, for speed brakes, hydraulic controls, fuel pumps and other internal moving parts, polyphenyl ethers can cope with the "heat barrier" to provide reliable performance.

Monsanto's polyphenyl ethers are a new link in the design chain leading to advanced engines and weapons systems with a minimum of "compromise" for lubricant and hydraulic fluid limitations. In present systems just "getting by" with marginal performance of earlier lubricants, the polyphenyl ethers can provide greater reliability.



SYNTHETIC FLUIDS FOR SPACE-AGE ENGINEERING

Monsanto has had 15 years' experience in the development of synthetic fluids and lubricants; currently markets over 20 fluids with applications that range from electronic coolant-dielectrics to fire-resistant hydraulic fluids for jets and radiation-resistant fluids for nuclear power plants.

If you require a fluid or lubricant for special use in an application of high stress, contact Monsanto. The material you need may be readily available or within "easy chemical reach." Write or call: MONSANTO CHEMICAL COMPANY, Department 02-A, C Building, St. Louis 66, Missouri.

Monsanto Space-Age Projects for Government and Industry

* High-Temperature Hydraulic Fluids
* Coolant-Dielectrics for Electronic Equipment
* High-Temperature Plastics
* Improved Nitrogen Oxidizers for Solid Propellants
* Fire-Resistant Structural Plastics
* Hydrocarbon Fuels for Jets and Missiles
* Fire-Resistant Hydraulic Fluids for Ground-Support and Missile-Launching Equipment
* Radiation-Resistant Heat-Transfer Fluids
* High-Temperature Lubricants and Additives
* Radiation-Resistant Reactor Coolant-Moderators
* Intermetallic Semiconductor Materials
* Pure Silicon for Transistors, Rectifiers, Diodes
* Ultra-Fine Metal Oxides
* Materials for Vibration Damping
* Heat-Resistant Resins for Laminating and Bonding
* Inorganic Polymers
* High-Energy Solid Propellants

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You are invited to work with Monsanto on your materials needs in the above fields.

AIRMAIL

The Full Report

Gentlemen: "The Crushing Burden of Disarmament," published in the August issue of AIR FORCE/SPACE DIGEST, opens a very interesting subject. Where could I get a copy of the full National Planning Association report from which it was taken?

Fred T. Williams
Denver, Colo.

• *The report, entitled "Strengthening the Government for Arms Control," is published by the National Planning Association, 1606 New Hampshire Ave., N. W., Washington 9, D. C. It costs $1 per copy and is well worth reading in its entirety.*—THE EDITORS

An Exchange of Correspondence

Dear Mr. Ward: I have read your interesting article on civil defense preparedness in the August 1960 issue of AIR FORCE Magazine.

It is a good article. For the most part, however, your defense is against the results of an attack using nuclear weapons. May I ask what, if any, measures are you prepared to take for defense against chemicals and bacteria?

M. H. Bigelow, Vice President
Plastics and Coal Chemicals Division
Allied Chemical Corporation
New York, N. Y.

Dear Mr. Bigelow: ... [This] brings up a most important phase of civil defense and one which, as you know, we are unable to cope with to a very effective extent. I have had considerable respect for chemical warfare since my first introduction to chemical warfare in the ROTC as early as 1931. As a member of the United States Civil Defense Council, and having just completed a four-and-a-half-day orientation course on Special Weapons at the Air University, I introduced a resolution at the September 1959 meeting of the Civil Defense Council in Dallas urging that the White House specifically designate responsible agencies of the government for the purpose of arriving at practical solutions for the protection of civilians against chemical and bacterial warfare.

You may be aware that OCDM has done a good deal along these lines and has already started making available for the coming academic year Protective Equipment Sets, Chemical Warfare Defense, V-855. This is a start on the protective program. I am sure that the Office of Civil and Defense Mobilization would be most grateful for any specific knowledge or suggestions that you might be able to offer.

In the meantime, the principal statement on bacterial and chemical warfare is best typified in the handbook entitled *Live*, which was prepared for the staff members and their families of the Stanford Research Institute. It says:

"Bacteriological and gas warfare have severe logistical limitations and are useful primarily for tactical purposes. They are particularly impractical for use against US retaliatory bases since they would not become effective immediately and would fail to prevent retaliatory attack. Thus, enemy use of these techniques is unlikely for the present, and the survival plans proposed in this booklet do not provide for bacteriological or gas hazards. When intelligence data indicate greater likelihood of such an attack, appropriate measures will be included in the plans."

This is pretty much the distillation of current informed thinking. . . .

Frank W. Ward
Civil Defense Coordinator
Battle Creek, Mich.

Less Talk—More Action

Gentlemen: Your August editorial, "Who's Deterring Whom?", which might just as well have been called "Who's Kidding Whom?", merits sincere congratulations on the rendering of a great public service.

In these days when our official government spokesmen speak to other nations, almost without exception in terms of fatuous banalities, it is extremely refreshing to note your plain-spoken warning in an area where the public is indifferent because it is ill-informed.

Yes, seventy-five of the cream of the crop have been murdered, and what do we do? We shoot back nothing but words, and we are even in process of extending our trade with these people.

Likewise, little Cuba develops into a virulent boil on the US national backside—steals our property, seduces our friends, harbors the people who murder our airmen on peaceful missions, and what do we do—more fatuous, banal words.

We agree, Mr. Editor, the deterrent business has truly become a two-way street, and the American public is fed to the teeth with the prevailing crop of fatuous words delivered to both friends and foes alike.

The remedy is obvious. We need a lot more national unity on the foreign front. Foreigners do not understand that politics are pretty much of a pinball game in the US, and that we can drop that game like a hot potato when the real bell rings.

Is it not about time that our appointed and elected civilian heads of state now speak up with four-letter words? It is their job to do this, because the heads of our armed forces are muzzled.

Your editorial ought to be broadcast on a national basis.

Capt. R. E. W. Harrison, USN (Ret.)
Washington, D. C.

UNIT REUNION

2d Air Division Association of the 8th Air Force—Oct. 14-16

Washington, D. C., Statler Hilton Hotel
Military and civilian personnel, British or American, who served with Headquarters organization of 2d Bomb Wing, 2d Bomb Div., or 2d Air Div. of any of its Wings or Groups during WW II in England.

Contact: Raymond E. Strong, Secretary
102 Bradley Rd.
Chapel Hill, N. C.

CORRECTION

The September issue of AIR FORCE noted a unit reunion for the 96th Bomb Wing, October 27-30, at Dyess AFB, Tex., and listed as the contact the *95th* Bomb Group Assn. The correct contact is the *96th*, an 8th AF B-17 outfit in WW II, reactivated in 1953 and now part of SAC.

U.S. AIR FORCE

Nav Aid exam 8 miles high

first assignment for the Air Force's new C-140 JetStar

America's ability to be constantly ready for strategic and tactical action throughout the free world is linked directly with the accuracy and reliability of our military navigational aids and air traffic control facilities. Now the Air Force has a high-flying electronics lab that can evaluate these aids realistically under operational jet flight conditions. Name of the plane – C-140 JetStar, made by LOCKHEED/GEORGIA.

Five of the new C-140's will go into service soon with the Airways and Air Communications Service arm of MATS. This important assignment is the first operational military role for the JetStar, which was developed by Lockheed to meet the Air Force's need for a multi-mission jet aircraft.

The JetStar operates nimbly in the high-altitude military traffic layer. With four Pratt & Whitney J-60 turbojets placed well back on the aft fuselage – behind the eardrums of the crew – the C-140 JetStar achieves Mach .8 cruising speeds. But the new C-140 is more than just quick and quiet. It's a stable platform that assures the accuracy of the sensitive electronic evaluating equipment. And the entire airplane is pressurized and air-conditioned to provide a comfortable working environment for both crew and equipment.

LOCKHEED

GEORGIA DIVISION • MARIETTA, GEORGIA

AT-THE-READY MISSILE SITE SUPPORT

WITH THE VERTOL 107

The Vertol 107, twin-turbine-powered helicopter, offers a new concept of dependability for all-weather, around-the-clock support of ICBM dispersed launching sites.

Under virtually every condition—including road-blocking storms, sabotage and enemy action—this advanced helicopter offers a most effective means of maintaining a continuous flow of essential men and materiel to remote missile launching sites.

For command inspection and high priority maintenance of missiles at scattered sites, the all-terrain Vertol 107 offers travel time reductions up to 90%. In addition, since personnel can be shuttled back and forth between home base and launching areas in minutes, the need for extensive housekeeping facilities at each site is eliminated. The Vertol 107 Model II can carry a 5,000-pound payload internally, externally—or, if necessary, half-in half-out—over a mission radius of 100 nautical miles—even on a hot day at 7,000-foot elevations.

The twin-turbine, tandem rotor Vertol 107—the most advanced helicopter flying today—offers a new high in dependability for the Strategic Air Command.

VERTOL DIVISION
MORTON PENNSYLVANIA
BOEING

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USAF

News,
Views
& Comments

AEROSPACE WORLD

Frederic M. Philips
ASSOCIATE EDITOR

Eight US airmen fell victim to sudden violence in the Congo this month. To chants of "kill, kill" from Congolese women, a goon squad of local fighting men viciously beat the eight unarmed crew members of a USAF C-124 Globemaster after it landed at Stanleyville with signal equipment for area UN forces.

The August 27 incident, worst involving UN personnel since the world organization went to the aid of the chaotic Congo, apparently resulted from the fact that a large crowd of Congolese at Stanleyville airport mistook the Americans for Belgians. The crowd, estimated at 10,000, had assembled to greet Congo Premier Patrice Lumumba on a visit to the city, capital of the new African state's eastern province.

Accounts of the experience from the airmen after rescue by UN troops rendered a horrifying picture. It was in harsh contrast with the rest of USAF's massive and impressive Congo airlift, which had operated with no major difficulties from mid-July on *(see "Airpower in the News," page 26).*

One crewman recalled that, after the plane had landed and been unloading for about half an hour, "a wild mob of soldiers and civilians began to beat our people with rifles, submachine guns, and clubs. Women and men in the crowd shouted 'kill, kill!' They danced around the beaten men, shoving each other to reach them, beating at the men's heads repeatedly as they tried to protect themselves without weapons."

Another of the Air Force men told newsmen, "I was approached by a Congolese civilian policeman. He asked me to follow him. I took my own time. He hit me with his fist in the mouth, and a shout went up from the crowd. That started it. I tried to run for the hangar, but I was hit with clubs and sticks and guns and fists."

When Premier Lumumba arrived, one man reported, some of the soldiers and civilians lifted the plane's beaten navigator into the air for him to see. Blood was streaming over the man's flying suit.

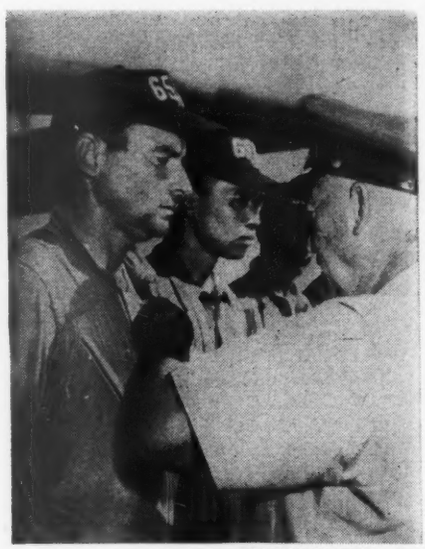
The gory proceedings came to an end when UN ground troops, most of them Ethiopians, reached the scene. All eight airmen were hospitalized, five in badly injured state. The goons' score for the evening was actually three higher than that total; two Canadians officers and a Swedish civilian were also worked over in a nearby bar. Some days earlier, in a similar incident, Congolese soldiers had attacked a small contingent of Canadians, who were bailed out here as well by African UN troops.

Seven of the airmen arrived home on September 7, some ten days later. A C-118 hospital plane brought them to McGuire AFB, N. J., in an eighteen-hour flight from Germany. Three were on stretchers. The eighth was the pilot, Capt. Elbert L. Mott, who remained in the hospital in Wiesbaden, Germany, with serious injuries.

☆

Gradually, inexorably the nation moves toward unified, streamlined organization of its armed might to meet the needs of the times. An important step in the process came this month with creation of a joint strategic targeting agency designed to ensure integrated use of our entire deterrent air arsenal—Air Force and Navy—in the event of aggression.

Named to head the new agency in an August 18 announcement from the Department of Defense was USAF Gen. Thomas S. Power, SAC Commander in Chief. Headquarters for the group was designated as Offutt AFB, Neb., home of SAC. Second in command of the all-service group, to have a staff of about forty officers, will be Navy Rear Adm. Edward N.



Wide World Photos, Inc.

Gen. Emmett O'Donnell, Jr., PACAF's Commander in Chief, pins DFC on Capt. Harold E. Mitchell, pilot of C-119 that caught Discoverer capsule on August 19. Crewmen got Air Medals.

Wide World Photos, Inc.

Capt. Joseph W. Kittinger, Jr., the USAF balloonist-parachutist who set new balloon ascent, jump, free-fall records on August 16 over New Mexico. He held three of the marks himself.

Parker, former Chief of the Defense Atomic Support Agency and a much-decorated World War II destroyer skipper.

Specific task of the group, set up on the basis of lengthy deliberations by the Joint Chiefs of Staff and Defense Secretary Thomas S. Gates, will be to draw up a list of targets and the weapons to be used against them. The Joint Chiefs will review and approve the list and the forces and weapons assigned to take them out. First integrated list was expected to be in the hands of JCS by the end of the year. The process of targeting in the current stage of technology and weaponry is an immensely complex one.

Actually, the new agency under General Powers represented a significant compromise between Air Force and Navy views. The Air Force had proposed the establishment of a joint strategic military command under a general or admiral to command all US retaliatory forces—USAF bombers and missiles, the Navy's Polaris missile submarines, and supposedly Navy carrier task forces under some conditions. Both services expressed satisfaction after announcement of the new group at Offutt.

☆

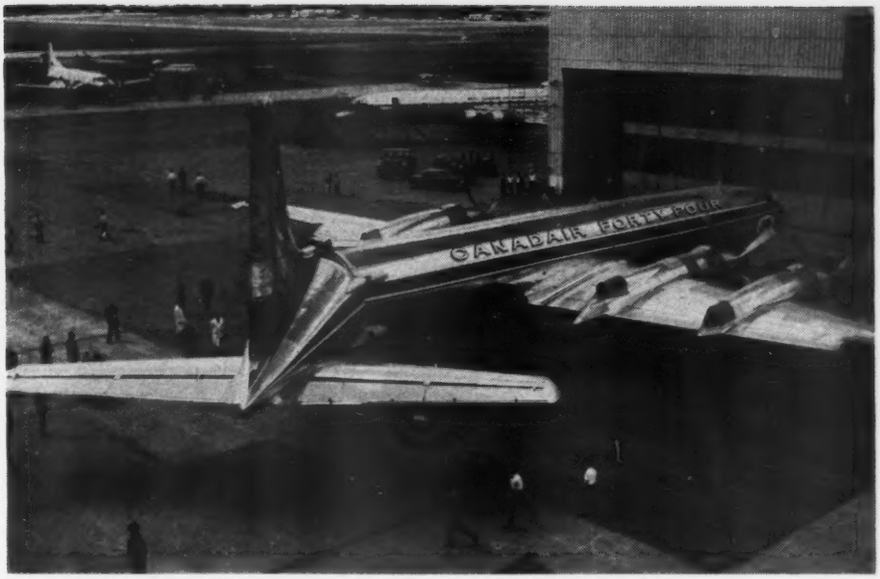
For the past three years, honors in the space race had been measured in terms of what went up. This month the accent switched to what came down.

What came down for the United States was the reentry capsule of the Air Force Discoverer XIV satellite. USAF staged an aerial recovery of such a capsule for the first time on August 19. A C-119 named *The Pelican Nine* made the catch with a seventy-five-foot loop of nylon rope some 360 miles west of Honolulu at an altitude of 8,000 feet. Discoverer XIV had been launched the day previous from Vandenburg AFB, Calif.

The C-119, piloted by Capt. Harold E. Mitchell (*see cut*), made three passes at the capsule as it plummeted toward the sea. On the third pass, he and his crew made history. The capsule carried instruments and equipment designed to speed development of space warning systems. Just eight days earlier, a Navy recovery vessel plucked the capsule of Discoverer XIII from the Pacific. These were the first two man-made objects known to have been recovered from outer space. Repeated efforts to recover Discoverer capsules had been recorded in the past.

Next day, August 20, recovery of object three was announced in Moscow. The Russians revealed that they had brought back a satellite capsule bearing two dogs, smaller animals, and plant life. They were said to have landed in good shape in a Russian field about 6.2 miles from the chosen impact area after about a day of orbiting. The Soviets thus became first to put live animals in space orbit and recover them successfully.

Purpose of the Russian shot was to investigate how living creatures could exist in space and be brought back. Both the US and Russian recoveries obviously brought nearer the day when it will be human beings, not dogs, mice, and fungi who voyage in the cosmos.



First swing-tail cargo plane ever built, Canadair Forty-Four, was rolled out at Montreal late in August. Plane is built by Canadair Ltd., a subsidiary of General Dynamics in Canada. Turboprop freighter enters service in US in 1961.

☆

Rah-rah-rah! Go, team, go! Hold that line! As this issue reaches its readers, another football season will be well under way, and so far as the preseason dopesters can be considered authoritative, the Air Force Academy could be destined for its best season yet.

Last season's record was five won, four lost, one tied, the cumulative record for the past two seasons fourteen wins, four losses, and three ties. High spot last year was a ringing 13-13 tie that the Academy Cadets managed against rugged West Point in New York's Yankee Stadium. It was the Academy's first meeting with one of the older service academies in football. Underdogs in the New York effort, the Colorado Springs lads came from behind to gain the standoff.

This year, the big game will be the second service meeting, this time against the Naval Academy in Baltimore's Municipal Stadium on October 15. Depending on what happens on the first few Saturdays of the year, the Academy could come up to the Navy game a favorite. As one forecaster put it, "Army and Navy are rebuilding this year. The Air Force Academy team may be tops among the service schools."

Big man in Academy coach Ben Martin's scheme of things figures once more to be quarterback Rich Mayo. Mayo, with two years of varsity football under his belt, is one of the nation's leading forward passers. He has thrown for seventeen touchdowns, completing 208 passes in 385 attempts with only sixteen interceptions. Many believe that he has an excellent chance of gaining All-American honors this year.

Also on the holdover list with Mayo are the team's leading scorer and ground gainer in the past two seasons, halfback Mike Quinlan, veteran fullback Monte Moorberg, and most of last year's line.

The team's ten-game 1960 schedule includes Colorado State, Stanford, Missouri, Navy, Wyoming, George Washington, Denver, UCLA, Colorado, and Miami. Of these, the Academy last year beat Wyoming and UCLA and lost to Missouri and Colorado.

Go, team, go!

☆

Never have problems of national security been more complex than they are today. Never has a continuing examination of its many facets been so much a condition of national strength. It was with these thoughts in mind that the General Electric Company launched its *Defense Quarterly* early in 1958.

Today, nine issues of this outstand-

(Continued on page 19)

Meet the newest member of the Sabre family

The T-39 Sabreliner is the Air Force's first twin-jet utility trainer. Now in production, it carries on the heritage of North American Aviation's renowned Sabre aircraft—the F-86 Sabre Jet and the F-100 Super Sabre.

Designed and built by North American for the Air Force, the versatile Sabreliner now is undergoing FAA certification that not only meets all military requirements but also civil specifications.

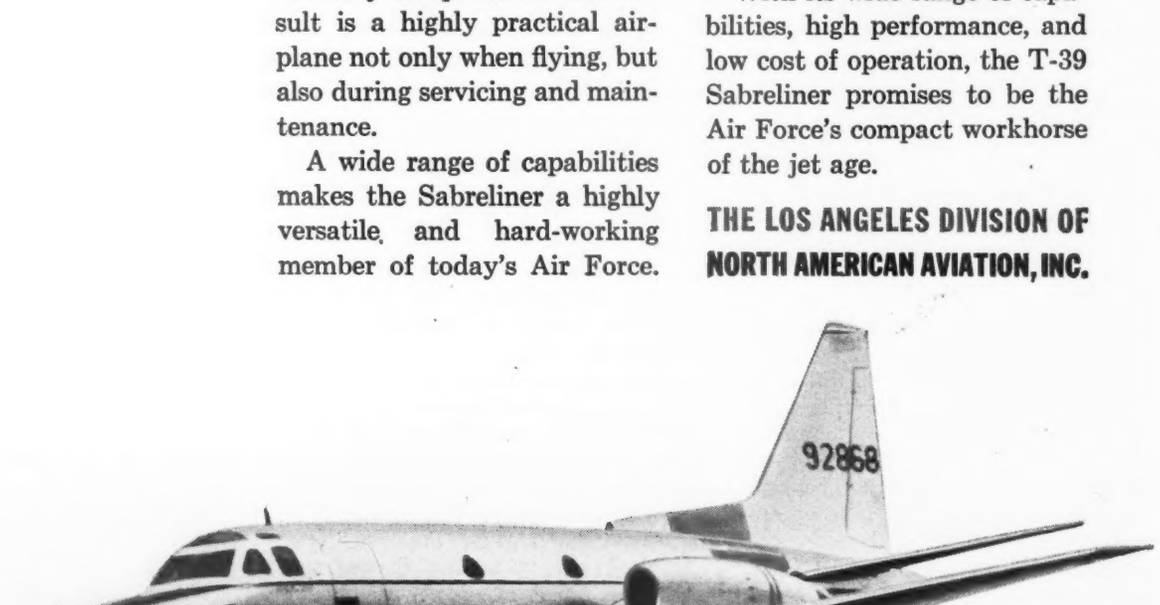
An important consideration in designing the Sabreliner was economy of operation. The result is a highly practical airplane not only when flying, but also during servicing and maintenance.

A wide range of capabilities makes the Sabreliner a highly versatile and hard-working member of today's Air Force. Carrying four students and a crew of two, it functions as a radar, navigation, or jet-proficiency trainer.

In performance, the Sabreliner rivals commercial jet airliners. Two Pratt and Whitney J-60 (JT-12) engines, with a thrust of 3000 pounds apiece, give it a cruising speed of 500 miles an hour at 40,000 feet, well above most weather. It can fly 1500 nautical miles without refueling, and can land or take off at the airport of almost any city.

With its wide range of capabilities, high performance, and low cost of operation, the T-39 Sabreliner promises to be the Air Force's compact workhorse of the jet age.

THE LOS ANGELES DIVISION OF NORTH AMERICAN AVIATION, INC.



THE T-39 SABRELINER

The young football season could be a big one for the Air Force Academy eleven. Above, a scene from last year's big game. Star passer Rich Mayo tosses against the Army.

PACAF surgeon Brig. Gen. Charles H. Morhouse, Japanese and US officials stand by one of iron lungs USAF flew to the polio-stricken Japanese island of Hokkaido in August.

ing magazine later, the *Quarterly* stands as a major regular contributor to wholesome national debate and examination in connection with areas of national defense thinking. The current issue, for example, deals with the broad topic of "Total Defense." Contributors include Gen. Thomas S. Power; Gordon Gray, Special Assistant to the President for National Security Affairs; Adm. Arthur W. Radford, USN (Ret.), former Chairman of the Joint Chiefs of Staff; Gen. J. Lawton Collins, USA (Ret.), former Army Chief of Staff; Adm. James S. Russell, USN, current Vice Chief of Naval Operations; and Dr. George L. Haller, Vice President of General Electric.

Previous issues this year, with equally distinguished panels of contributors, have explored the subjects, "Managing Our Resources for Defense and Prosperity" and "Defense Needs and Economic Growth." In April of this year, the Institute for American Strategy cited the GE *Quarterly* for "singular service in improving public understanding of national security affairs."

In the foreword to its current number, the editors of the *Quarterly* speak out strongly for "a national strategy for total defense" based in "the unity and confidence of the American public." The publication's contribution to the strengthening of America and establishment of such across-the-board defense planning is itself notable.

☆

ELSEWHERE IN THE AEROSPACE WORLD:

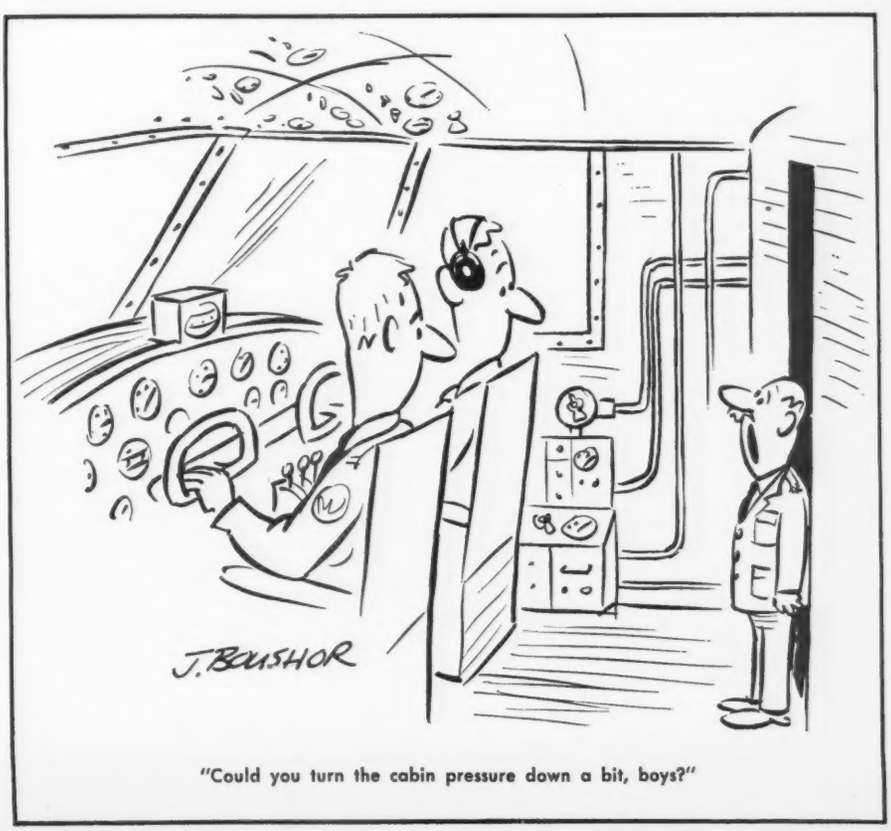
The Collier Trophy, major aviation honor presented each year by the National Aeronautic Association, will go this year to the United States Air Force, the Convair Division of the General Dynamics Corporation, and Space Technology Laboratories for the Atlas program, it was announced in the middle of September. This is the first time the Collier Trophy, established in 1911, will have been given in the field of astronautics. Choice of Collier Trophy winner is made each year by an NAA committee headed by Association President Jacqueline Cochran.

The three-day Moscow trial of U-2 pilot Francis Gary Powers ended on August 19. The "spy plane" flyer received a ten-year sentence, the first three in prison and the rest supposedly in a work camp.

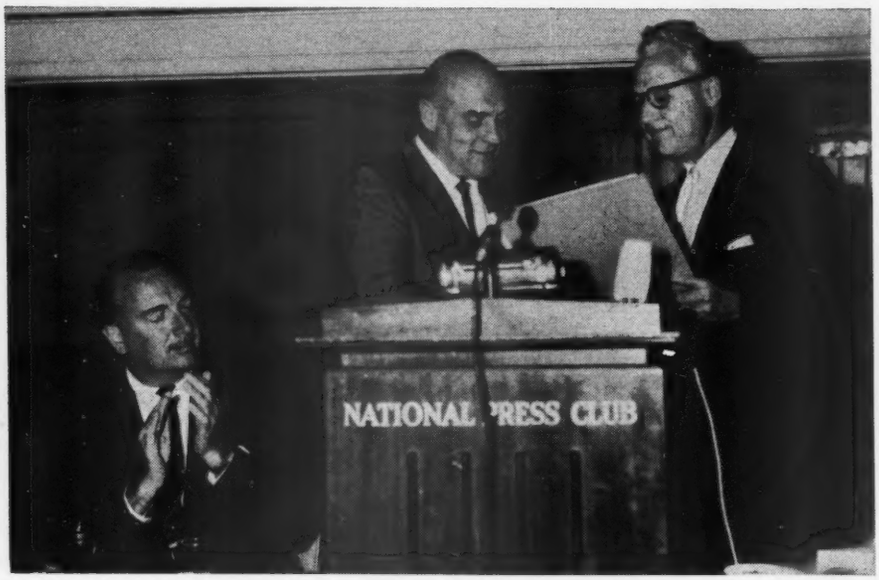
On August 18, the same day Discoverer XIV was launched at the Cape, a USAF attempt to launch an Army Courier I communications satellite with a Thor-Able-Star booster failed.

Announcement came on August 30 that USAF Gen. Nathan F. Twining

(Continued on following page)



"Could you turn the cabin pressure down a bit, boys?"



AFA Executive Director James H. Straubel receives Aviation and Space Writers Association award for first World Congress of Flight from *Flight* Magazine editor George Haddaway. Looking on is radio-TV's Walter Cronkite, recipient of USAF award for services to reserve program, at the same luncheon ceremony.

retires September 30 as Chairman of JCS, Army Gen. Lyman Lemnitzer succeeding him.

MATS and TAC aircraft flew iron lungs *(see cut)* and chest respirators to Hokkaido, northernmost Japanese island, in late August to combat the worst polio epidemic ever experienced there.

In missile testing, the second successful shot of an operational-type Titan ICBM took place at the Cape on August 30.

New commander of the 1,800-Cadet Wing at the Air Force Academy was named. He is William T. Williams, IV, of Lexington, Ky. Cadet Williams holds the highest Wing rank, Cadet Colonel. At the same time, 110 Cadets were named to the Superintendent's List, which recognized scholastic and all-around achievement, for the spring 1960 term.

On August 31, Congress voted $100,000 to an Air Force colonel who invented a low-altitude bombing system and equipment but could not protect the patent on it because it was too secret. The officer was ARDC's Col. John A. Ryan, Jr. The Air Force told Congress that Colonel Ryan performed his work on the system outside of regular duty hours at Wright-Patterson AFB, Ohio, and had been granted the right to patent it with the provision that the US could use it without fee. The security classification prevented him, however, from obtaining patents abroad even though the system was said to be in use in many allied nations' air arms. Under the conditions, USAF said, a $100,000 award was just for Colonel Ryan, who is presently stationed at Hanscom Field, Mass.

Seven world records fell to Army pilots flying HU-1 Iroquois helicopters during the eight-day span ending July 26, the service announced in early August. Broken were three records held previously by Russians and two held by Frenchman. The marks were for speed, time to climb, and distance in a number of helicopter categories.

Air Force doctor Capt. Thomas O. Nevison, Jr., is currently taking part in an expedition led by Sir Edmund Hillary, the conqueror of Mount Everest, up Mount Makalu in Nepal. Mount Makalu, at 27,790 feet, is fifth highest mountain in the world. Dr. Nevison was physician on the US expedition that climbed 26,740-foot Gasherbrum I, Nepal, highest peak ever climbed by an American party, in 1958. The hope is that medical data obtained in this new climb may contribute information in the human factors area of the US man-in-space program.

The Industrial College of the Armed Forces has announced a correspondence course entitled "The Economics of National Security" available free to active or inactive military officers at the grade of major or lieutenant commander or higher, as well as to federal employees at the level of GS-11 and higher. The correspondence offering is based on a ten-month resident course given at the college at Fort Lesley J. McNair, Washington, D. C. Interested persons should contact the school.

A recently released Air Force fact sheet on unidentified flying objects states that 173 "sightings" of such phenomena were reported to USAF during the first six months of this year. Of the 173, 139 had been analyzed at that point, with thirty-four still pending today. In no case was it judged by USAF that the phenomenon was other than (1) natural, (2) easily classifiable as hoax, illusion, or the product of an overworked imagination. A large percentage turned out to be planes, balloons, or astronomical phenomena. "No unidentified aerial phenomena," USAF said, "gave any indication of a threat to the security of the United States."

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STAFF CHANGES. . . . Brig. Gen. Charles R. Bond, Jr., from Commander, San Francisco Air Defense Sector, ADC, and NORAD, with duty station at Hamilton AFB, Calif., to Deputy Commander, 5th Allied Tactical Air Force, APO 221, N. Y. . . . **Maj. Gen. William M. Canterbury,** from Commander, Air Force Research Division, ARDC, Washington, D. C., to Commander, Air Force Missile Development Center, ARDC, Holloman AFB, N. M. . . . **Brig. Gen. William E. Creer,** from Commander, 801st Air Division, SAC, Lockbourne AFB, Ohio, to Commander, 72d Bomber Wing (Heavy), SAC, APO 845, N. Y. . . . **Maj. Gen. Herbert L. Grills,** from Deputy Commander, 5th Allied Tactical Air Force, APO 221, N. Y., to Assistant to Commander, Hq. ATC, Randolph AFB, Tex. . . . **Brig. Gen. Benjamin G. Holzman,** from Vice Commander, Air Force Research Division, ARDC, Washington, D. C., to Commander, Air Force Cambridge Research Laboratories, ARDC, Laurence G. Hanscom Field, Mass. . . . **Maj. Gen. Daniel E. Hooks,** from Commander, Air Force Missile Development Center, ARDC, Holloman AFB, N. M., to Commander, Air Force Research Division, ARDC, Washington, D. C.

Brig. Gen. Thomas K. McGehee, from Commander, Grand Forks Air Defense Sector, ADC, and NORAD, Grand Forks AFB, N. D., to Commander, San Francisco Air Defense Sector, ADC, and NORAD, Beale AFB, Calif. . . . **Brig. Gen. Melvin F. McNickle,** from Assistant to DCS/Research and Engineering, Hq. ARDC, Andrews AFB, Washington, D. C., to Director of Supply and Services, DCS/M, Hq. USAF, Washington, D. C. . . . **Maj. Gen. Joseph J. Preston,** from Commander, 72d Bomber Wing (Heavy), SAC, APO 845, N. Y., to Commander, 4061st Air Refueling Wing, SAC, Malmstrom AFB, Mont. . . . **Maj. Gen. Hewitt T. Wheless,** from Director of Plans, DCS/P-P, Hq. USAF, Washington, D. C., to Director of Plans, Hq. SAC, Offutt AFB, Neb.

RETIRED. . . . Maj. Gen. Richard A. **Grussendorf,** Brig. Gen. Charles E. **Jung,** Maj. Gen. Beverly H. **Warren.**—END

KOLLMORGEN EYE SITE FOR ATLAS. Kollmorgen's Type 501 Telescope has been specified to boresight the tracking antenna of the General Electric radar command guidance system for the Atlas ICBM. Type 501 incorporates unique features which permit pinpoint precision in sighting and collimating. Reticles at both ends of the scope allow you to sight on infinity, transfer the eyepiece to the other end of the instrument, and sight back azimuth accurate to one second of arc without moving the telescope body. It is possible to focus from infinity to 500 feet with no deviation in the line of sight.

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Resumes invited from qualified optical engineers

What's New With ★ RED AIRPOWER

Here's a summary of the latest available information on Soviet air intelligence. Because of the nature of this material, we are not able to disclose our sources, nor document the information beyond assurance that the sources are trustworthy.

Here are some interesting excerpts from a recently published Soviet discussion of military strategy. It appeared in *Red Star,* the Russian Army newspaper, under the byline of Col. I. Grudinin.

● "The future war . . . will be a war of nuclear and rocket weapons, radio-electronics, and other highly complex war technology. There is no doubt that rockets and nuclear weapons will be the chief means of destruction and of striking massive blows at the enemy. Rockets and nuclear weapons are practically unlimited in range and highly accurate in hitting targets. . . .

● **"The use of these weapons will demand a troop mobility never before known; troops will have to wage bitter and fluid battles and engagements in the absence of a solid front to fulfill combat tasks often independently as individual units and subunits acting in different directions and at high speeds and to penetrate deep behind the enemy's positions. . . .**

● "The new battle equipment and weapons have raised still further the significance of such command qualities as independence, determination, initiative in action, strength of will, persistence in carrying out decisions, and to evaluate changing situations quickly and precisely."

* * *

Russian aviators continue to post new records. In August, the Soviets reported that Red Air Force Lt. Col. Boris Adrianov had set a new 100-kilometer closed-course mark of 1,297.8 mph, topping that established by USAF Brig. Gen. Joseph H. Moore last December. General Moore flew his F-105 at 1,216.48 mph. Other new Russian records reported are for helicopters, gliding, and cargo hauling.

Eight new records were listed for the TU-114 transport. The plane was said to have averaged 546 mph over the 3,100-mile Moscow-Sverdlovsk-Sevastopol-Moscow route, completing the distance in five hours, forty-three minutes, and fourteen seconds. The flight broke existing records over the distance for one-, two-, five-, and ten-ton payloads. The TU-114 also became the first turboprop transport to fly the distance with payloads of fifteen, twenty, and twenty-five tons.

The copter and glider records were these: First, 87.8 mph over a 1,000-kilometer closed course in an MI-1 heli-

copter. Second, a 342-mile straight-distance flight of 342 miles at 93.7 mph, also by an MI-1, this one with a woman at the controls; it was said to be a helicopter distance record for women. Third, a single-place glider flight by a woman over a triangular 100-kilometer course at an average speed of fifty-four mph.

• • •

Soviet Marshal Andrei A. Grechko has replaced Marshal Ivan S. Konev as military commander for the Warsaw Pact Nations, the Soviet-satellite organization that is a counterpart to NATO. Grechko has been First Deputy Minister of Defense directly under Defense Minister Marshal Rodion Y. Malinovsky. Grechko is the most likely candidate to someday replace Malinovsky. Grechko is one of Khrushchev's old friends and close associates. So is Malinovsky.

Konev is reported to be retiring because of illness. Though long loyal to the Khrushchev regime, Konev is not rated high for intelligence. When he was Soviet commissioner in Austria following World War II, he frequently clashed with the US commander, Gen. Mark Clark, who called Konev a "mental robot."

• • •

The Soviet cousin to the Lockheed Electra is having trouble, just like its American counterpart. All IL-18s were recently grounded, at least for a brief period. The grounding followed a midair explosion near Kier.

The Russians in the past have played down the AN-10 turboprop transport in favor of the IL-18 for civil use. But they have turned out large numbers of AN-10s for military use.

The military AN-10 has some interesting features. One is an upswept rear fuselage that houses a new combination door and loading ramp similar to that of the C-123 built by Fairchild for the US Air Force. The military AN-10 also has a manned tail-gunner's position built into the base of the vertical stabilizer.

The civil version is equipped with small vertical fins mounted on the tips of the horizontal stabilizers to improve control at slow speeds. Instead of these, the military version has a very large vertical fin that extends from the root of the vertical stabilizer well forward along the top of the fuselage.

• • •

The Russians say they are working on a supersonic transport and expect to have one flying as soon as the US does. This word came out of the visit of a Soviet delegation to the US in July to discuss US-Soviet air service. The US called negotiations off in the face of stepped-up Red cold-war efforts.

The issue of opening direct Aeroflot-US line service between the two nations has been hanging for some time. There was no indication of when talks would now be held.

• • •

Soviet military attaches got an eyeful in August when they toured the exhibits on display at the Sheraton-Park Hotel during the annual meeting of the Association of the US Army. One item the Russians took great interest in was the Redeye hand-carried antiaircraft weapon, displayed for the first time during the show and until recently classified "Secret."

The Reds attended the convention for the full three days and wore identification badges just like anyone else, looked at everything, and asked questions. They offered absolutely no information of their own, but listened intently and walked off with packs of literature on the weapons and equipment displayed.—END

BOUNDARY LAYER BREAKTHROUGH

50-ton BLC*-130 lands on 500-foot lightplane strips.

At the turn-around point of a 2,000-mile round trip mission, Lockheed's new Boundary Layer Control C-130 will roll to a stop in 520 feet after touchdown. Takeoff is just as remarkable: lift-off in 500 feet—from an unprepared field. Stall speed: less than 50 knots.

The BLC-130 is built on a proved and paid-for airframe design. It adds true STOL capability to the other C-130 superiorities established in more than three years of Air Force service: fast loading and unloading; rough-field takeoff and landing; performance of diverse airfreight/airdrop missions at low cost; and direct-to-trouble-spot airlift, such as the recent Congo airlift in which C-130s played the major role.

A test bed BLC-130 has completed flight tests, clearly demonstrating the feasibility of boundary layer control on large airplanes.

LOCKHEED

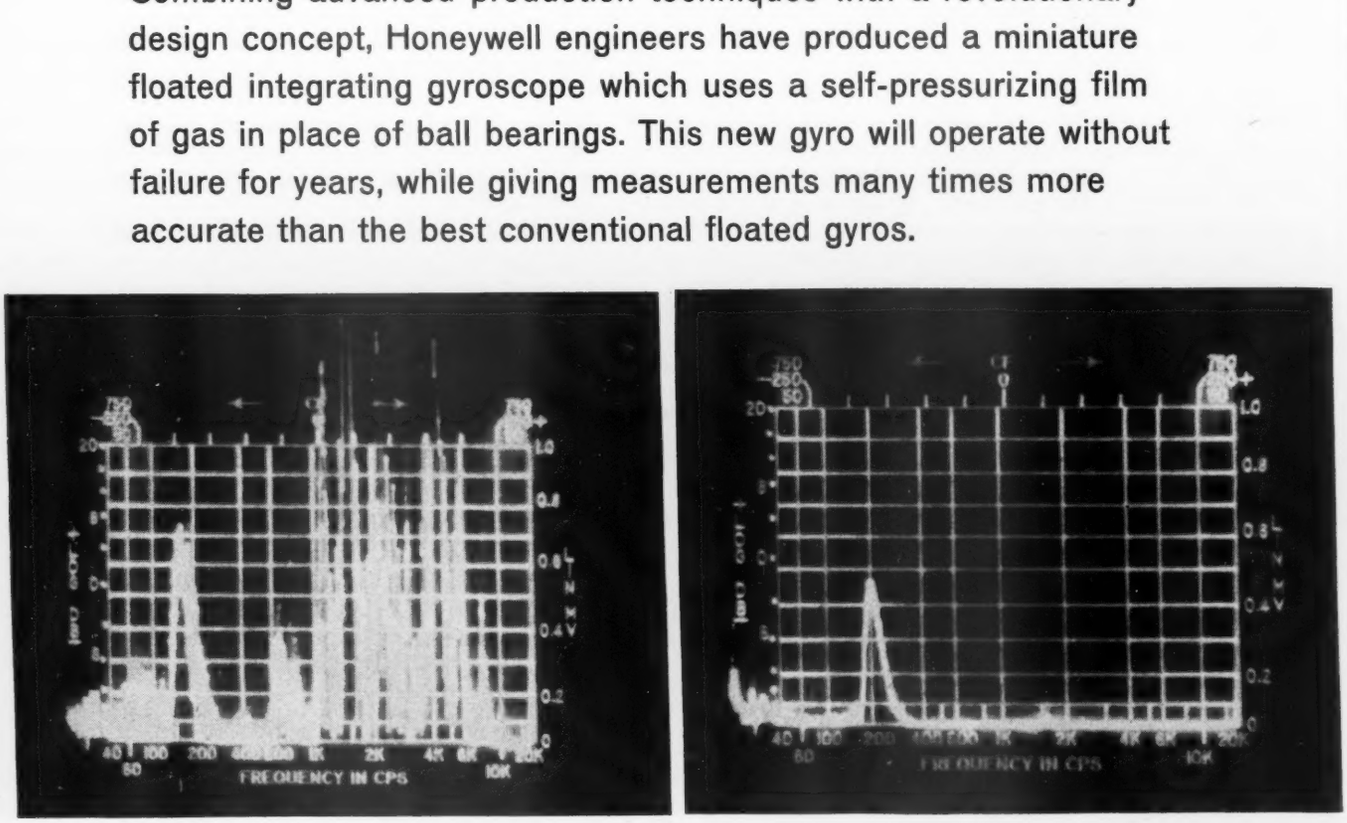
GEORGIA DIVISION • MARIETTA, GEORGIA

*BOUNDARY LAYER CONTROL—High-speed air from pylon-mounted turbojet compressors is blown over flaps, ailerons, elevator, and rudder—causing airstream to hug the surfaces instead of being separated. The energization of surface air gives the BLC-130 its extraordinarily high lift.

A Major Advance in Gyroscope Technology

New Honeywell Gas Greatly Improves

Combining advanced production techniques with a revolutionary design concept, Honeywell engineers have produced a miniature floated integrating gyroscope which uses a self-pressurizing film of gas in place of ball bearings. This new gyro will operate without failure for years, while giving measurements many times more accurate than the best conventional floated gyros.



These unretouched photos show noise reduction accomplished by Honeywell's new gas bearing gyro. Bearing noise gives an accurate indication of bearing uncertainties. Photo at left shows screen of a panoramic sonic analyzer displaying the output from acceleration-type pickoffs attached to conventional inertial-grade floated gyro (GG49) spin motor mount. Photo at right shows same set-up operating at same gain, displaying noise output from spin motor mount of this new gyro. Noise reduction is about 30 to 1.

Five years of research and engineering effort at Honeywell have culminated in the successful development, test and production of the first miniature floated rate integrating gyro with gas bearing spin motor. Even the finest ball bearing spin motor suspension places limitations on gyro life and performance. In Honeywell's new gas bearing MIG the conventional ball bearing spin motor has been replaced with a completely new gas bearing spin motor. Tests show that the new gyro will operate reliably for years instead of months, while performing many times as well as existing gyros.

Although the sole purpose of a gyroscope is to measure angular motion, existing gyros also respond to vibration and to other phenomena such as changes in temperature and pressure. These variables produce unwanted torques that interfere with the true angular motion torque signal. For systems requiring great accuracy, the need to reduce these torques has become more urgent than ever.

Two kinds of unwanted torques present the most serious obstacles to gyro accuracy. These are *friction* torque, which masks some of the lower-level true gyroscopic torque and thereby limits the threshold capability of the gyro—and *unbalance* torque, which appears as angular motion or drift.

The development of floated gimbals greatly reduced the problem presented by friction torque. For example, flotation of more than 99% of the gimbal weight has now reduced friction to about 0.001 dyne-centimeters.

Unbalance torques are most often associated with the spin motor and spin motor bearings. There are four primary areas in which the gas bearing gyro offers appreciable advantages in minimizing the following uncertainties:

1. Torques resulting from mechanical rectifications of vibrations set up

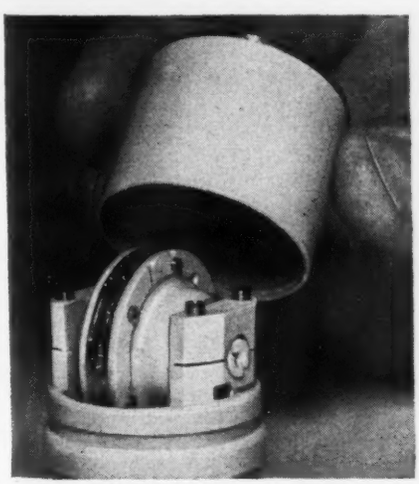
Bearing Gyro Reliability, Performance

throughout the bearing.

2. Torques resulting from movement of the ball retainers and shifts of balls in the raceway.
3. Mechanical hysteresis resulting from material damping and ball slippage.
4. Deformations resulting from stresses imposed on the balls by various motions of the gyro.

To the extent that these torques are regular and, within a given gyro, repeatable, it is possible to balance them out by trim adjustments. But there still remain some that cannot be compensated for because they are inconsistent. These are the torques that establish the true uncertainty level of the gyro and set its drift pattern. It is in improved control of these torques that the gas bearing spin motor has made its remarkable contribution.

The gas bearing eliminates the balls and retainers, substitutes viscous damping for hysteresis damping, and reduces to near zero, deformations resulting from thermal expansion. With this new spin motor, bearing noise is reduced by a ratio of 30 to 1, as shown in the untouched photographic records of the sonic analysis on the page at left.

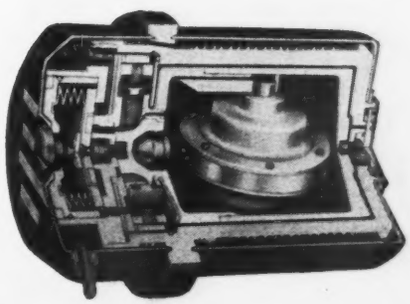


Ceramic Gimbal and spin motor of Honeywell's new GG124 Gas Bearing Gyro. Extreme hardness, great dimensional stability, and stiffness of this new ceramic material permits gyro to operate for years without failure, while performing many times better than conventional gyros.

The development of a miniature gas bearing spin motor to be housed in a gimbal as small as that of the Honeywell MIG was no simple task of scaling down a larger gas bearing motor. Gas does not exhibit the thin film lubricant properties of oil, and it will serve as an adequate bearing lubricant only if the bearing geometry is proper. A gas bearing depends upon viscous shear which drags the gas down a narrow passageway where it is squeezed through a wedge-shaped area. As the gas is squeezed, its pressure increases so that it will support a load. In the journal bearing, the load automatically produces the "wedge" area.

While the gas bearing spin motor is running, there is no contact of the bearing elements, and wear is virtually eliminated. However, there is some surface-to-surface contact on starting and stopping, and for this reason great care had to be taken in the choice and development of the material. The critical factors were dimensional stability, hardness, stiffness and cleanability. Honeywell engineers worked out a solution that has resulted in a gyro that shows no measurable wear after several thousand starts and stops.

Honeywell has accomplished a major breakthrough with the development of the miniaturized ceramic spin motor and shaft. The extreme hardness of this new material requires that it be finished with special diamond tooling. This new ceramic material has great dimensional stability over a wide temperature range and throughout a long life. The ceramic is extremely stiff—another advantage, particularly for a bearing shaft.



Cutaway drawing of Honeywell's new GG124 Gas Bearing MIG. The ceramic spin motor is located in the floated ceramic gimbal at right. Running at 24,000 RPM, the spin motor is suspended on a self-contained film of gas less than 50 millionths of an inch thick. The GG124 weighs 8 ounces and measures 2.8" long by 1.8" in diameter.

The stability of this new ceramic also makes it more attractive than metals for use in other parts of the gyro such as the gimbal, the coil cup, and the encapsulation for the stator.

Contamination has always been critical in the manufacture of floated gyros. With extremely small clearances in the gas bearing spin motor, a one-micron dust particle (39.37 millionths) cannot be tolerated. Ceramic parts can be cleaned with an acid which dissolves everything but the ceramic, allowing improved production cleaning and assembly techniques.

The GG124 will have far-reaching applications. It is a logical outgrowth of Honeywell's scientific and technical strength, its systems engineering, and its ability to complete the cycle from research through production quickly and effectively. Write: Minneapolis-Honeywell, Dept. AF-10-158, 2600 Ridgway Rd., Minneapolis 13, Minnesota.

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AIRPOWER in the news

Claude Witze
SENIOR EDITOR

School for Beginners

EVREUX, FRANCE

Between mid-July and the end of August, USAF's 322d Air Division, with headquarters at this base southwest of Paris, has hauled 5,828,651 pounds of cargo and 17,206 passengers to the Congo area. None of the Military Air Transport Service's critics was on hand to learn the lessons of Operation New Tape, but the lessons are in the record and must be passed along. They must go into the next study of military airlift capability.

They will show, possibly with more effect than the Berlin Airlift, the Lebanon crisis, Formosa, or a host of exercises like Big Slam/Puerto Pine, why military airlift is a military mission. They will show why modernization of our military transport fleet is an essential part of America's and the free world's airpower. They will show, on top of all this, that USAF has in these six weeks carried out a difficult assignment, quietly and efficiently.

In doing it, USAF has won a battle in the cold war, elevated our prestige in the United Nations, and demonstrated to the Russians our determination to use our capabilities when they are needed. In the turmoil that still exists in Africa and the loose talk that has come from Moscow about armed intervention, this demonstration has military significance far beyond the movement of UN police forces into a remote state. It has shown how fast a limited-war capability can be provided, given proper equipment, and a force in being trained to carry out the assignment.

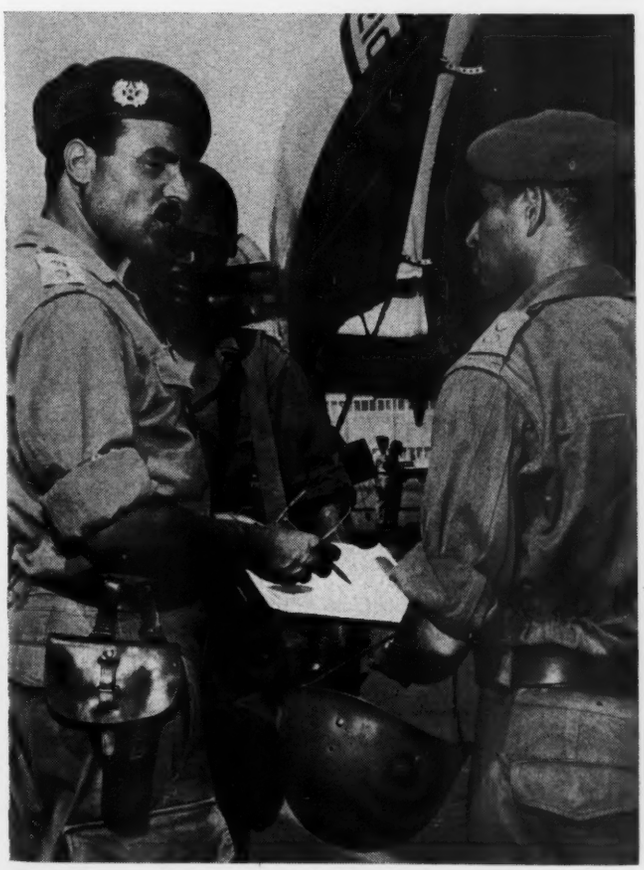
The officers and airmen of the 322d Air Division did not prepare for the Congo operation by training with flight simulators. Col. Tarleton H. Watkins, commander of the unit, has been running a military transport operation for a long time. His C-130 Lockheed Hercules transports normally operate over scheduled runs throughout Europe, the Near and Middle East. This provided the kind of training for his crews that could, and did, pay off with high dividends in the Congo situation.

The first order, received on July 14, was for an airlift of flour and Tunisian troops into Leopoldville. It took an hour and five minutes to get the first C-130 out of Evreux with a Combat Airlift Support Unit of forty-four men. They were in Leopoldville the next morning, setting up a headquarters in an abandoned hangar at Ndjili Airport. There were no reliable communications. There were inadequate charts and information about instrument facilities and approach procedures. Necessary maps were scrounged from French, British, and Belgian sources. At first there was a requirement for sixty navigation kits. It grew to 100 and then to 175. There were airports that would be saturated if more than two or three planes were on the ground at the same time. There were fields where

(Continued on page 28)

MATS C-124 transport loads heavily burdened Moroccan UN troops at Sidi Slimane AB, Morocco, for transportation to Congo. Plane is one of USAF fleet that has played impressive role in world organization's effort in new African state.

Combat-equipped Moroccan soldier wearing hastily prepared UN arm band pauses outside MATS plane before departure for Congo. USAF's 322d Air Division hauled 17,206 passengers to Congo in six weeks from mid-July to the end of August.



Last-minute instructions to Moroccan soldiers before boarding airlift planes. Difficult USAF airlift went smoothly, efficiently for most part despite conditions.

Inside plane on the way to Congo. Only serious incident in Congo for USAF was savage assault on C-124 crewmen by a mob at Stanleyville. But airlift has been tedious.

Lt. Gen. Benhamou Kettani, commander of Royal Moroccan contingent and Deputy Commander in Chief of the UN force in the Congo, discusses the airlift with one of his men.

no information was available about the fuel supply and others where misinformation was deliberately given out.

Yet on July 15 the airlift of food was started. More than 600,000 pounds of flour were hauled from Chateauroux, France, to Leopoldville. Two days later the C-130s began carrying 100 tons of food from Lome, Togo, to the Congo capital. By July 20 the 322d had more than twenty aircraft lifting food—1,250,000 pounds of it—from Bordeaux, France. In six weeks the total of food lifted to the Congo was 2,507,802 pounds. In the same period UN troops were carried in from Tunis, Morocco, Accra, Egypt, Guinea, Ethiopia, and Liberia. There have been 13,932 troops with 3,268,738 pounds of equipment. This includes 637 Irish soldiers and their gear hauled from Dublin on seventeen C-130s. It was the first time Irish troops had been out of their homeland in forty years.

On return flights from the Congo, the C-130s were packed with refugees. There has been no accurate count of this traffic, but Colonel Watkins estimates that 5,000 were evacuated. Nearly half of these were flown into Europe. Medical care and nursing assistance for hundreds of children were part of the job.

The route into Africa usually started at Wheelus Air Base in Libya and then south across the deserts and jungle. Another route was down the west coast of Africa with stops at Dakar and Accra. In either case a haul from Evreux or Brussels ran from 3,500 to nearly 5,000 miles, and a round trip in the C-130 averaged around thirty-three hours. At the outset the men in Africa, lacking communications, did not know when to expect flights. After a pilot was 500 miles south of Wheelus he had almost no contact by radio and location of an aircraft south of Kano, Nigeria, could be affirmed only through combined radiotelephone hookups. More positive control was not possible until the 322d moved in USAF and Army radio equipment. These units were set up at Kano, both to communicate with the aircraft and complete the link between Wheelus and Leopoldville.

The importance of modern equipment was realized in the contrast in performance between the C-130 and that of about fifty older Douglas C-124 transports thrown into the operation by the Military Air Transport Service. A trip which can be made in thirteen hours by the C-130, a turboprop, would require nearly twenty hours in the piston-powered C-124. Pressurized, the C-130 flew high above weather that handicapped the obsolescent C-124. In addition, there were performance features of the C-130 that permitted it to operate at top efficiency from airports where the C-124 was handicapped by runway length, temperature, or a combination of the two. The C-130 consistently hauled bigger loads than the older aircraft. There were no major accidents.

Apart from the C-124 crew that was assaulted by a savage mob at Stanleyville, the hardships of officers and airmen were confined to long hours of hard work and a diet of C rations. Maintenance crews were dispersed over Africa. Mobile teams from the 317th Consolidated Aircraft Maintenance Squadron were in more than twenty countries and all on a twenty-four-hour alert. They were ready for any job in such scattered places as Belgium, Greece, Spain, Pakistan, Ireland, Nigeria, Togo, Ethiopia, Ghana, Sudan, India, Egypt, and the new Republic of the Congo. Permanent maintenance terminals were set up at Wheelus, Kano in Nigeria, and Leopoldville.

The USAF history being made by the 322d is not one that is being adequately recorded in a day when the eyes of the world are looking up in space or around a nation where a presidential campaign is under way. But it is an application of airpower that cannot be missed by those who need to be impressed. These include other nations in front of and behind the Iron Curtain, as well as domestic interests which deplore the military need for airlift.

Let's Fight the Cold War

PARIS, FRANCE

The prestige for which the 322d Air Division has been fighting in the Congo is more than the prestige of the United States. It is the prestige of the United Nations, which has faced up to Russia with a determination that civil war will not develop, giving the Reds a chance to intervene and threaten world peace. Yet it is clear that not all members of the UN family want this completely understood. The story of the 322d's accomplishment is not being adequately told to the people of the world, including Americans. The reason, believe it or not, is that there are forces on the side of freedom that frown on this use of airpower. An effort to set up a press briefing on the Congo airlift was killed in the French capital, on a request from the French government that won support from our State Department.

There are two thoughts about the reason for this French attitude of mild horror. One is that the use of a French base as the command headquarters is repugnant to the de Gaulle administration, somewhat in the way that it objected to the storage of nuclear weapons in this country under control of the US. The other, probably more pertinent, reason is the situation in Algeria, where a war has been raging for six years, and the French have refused to recognize a rebel government. If the UN force, airlifted by USAF, manages to carry out a successful action in the Congo, there is the peril, in French eyes, that there will be a precedent for further movement as unrest in Africa spreads. France has a big stake in Algeria. It may not be the six percent of the national economy that the Congo represented to Belgium, but it is substantial, and France has a staggering investment in the war they have been waging since long before de Gaulle came into power.

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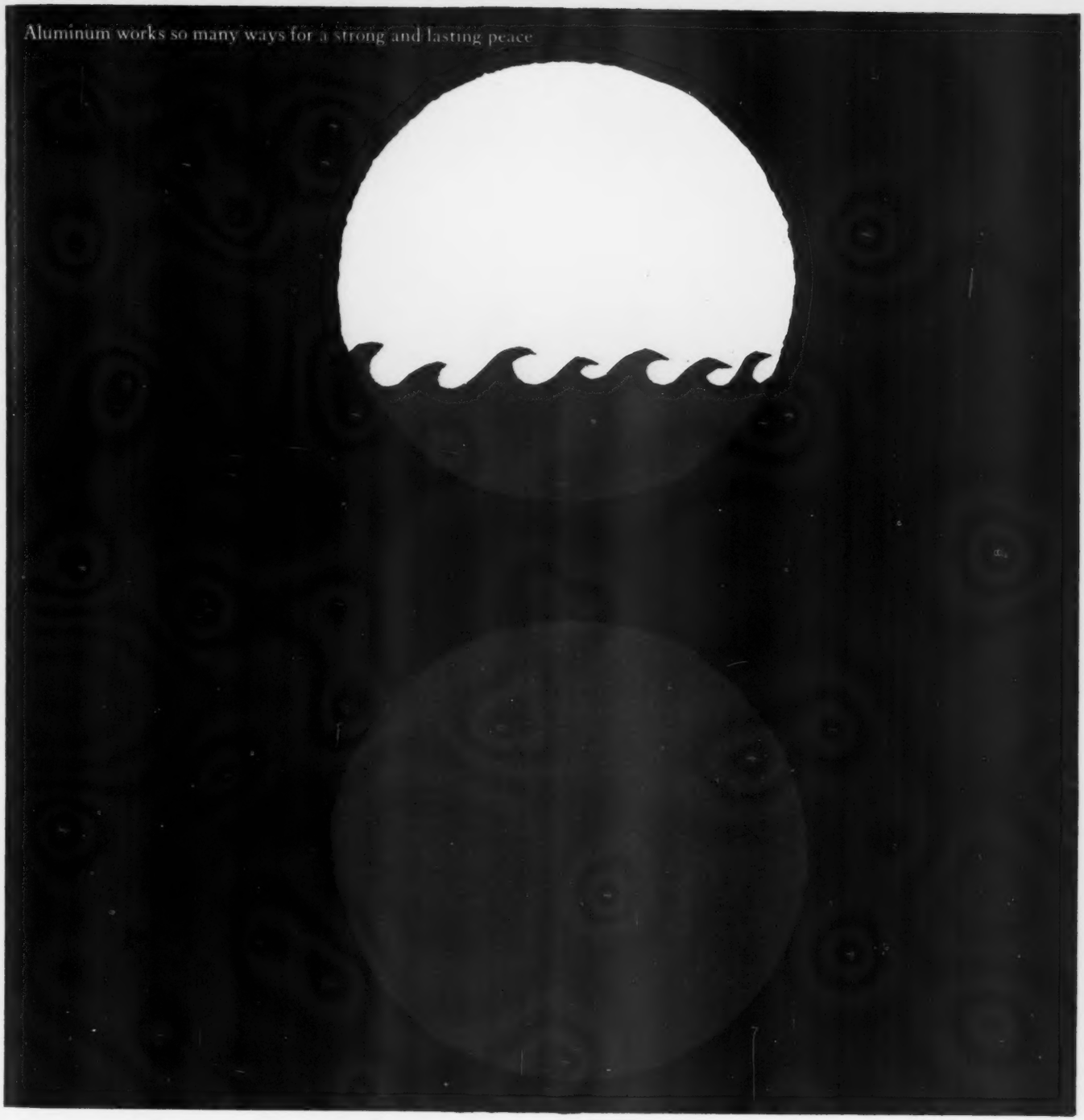

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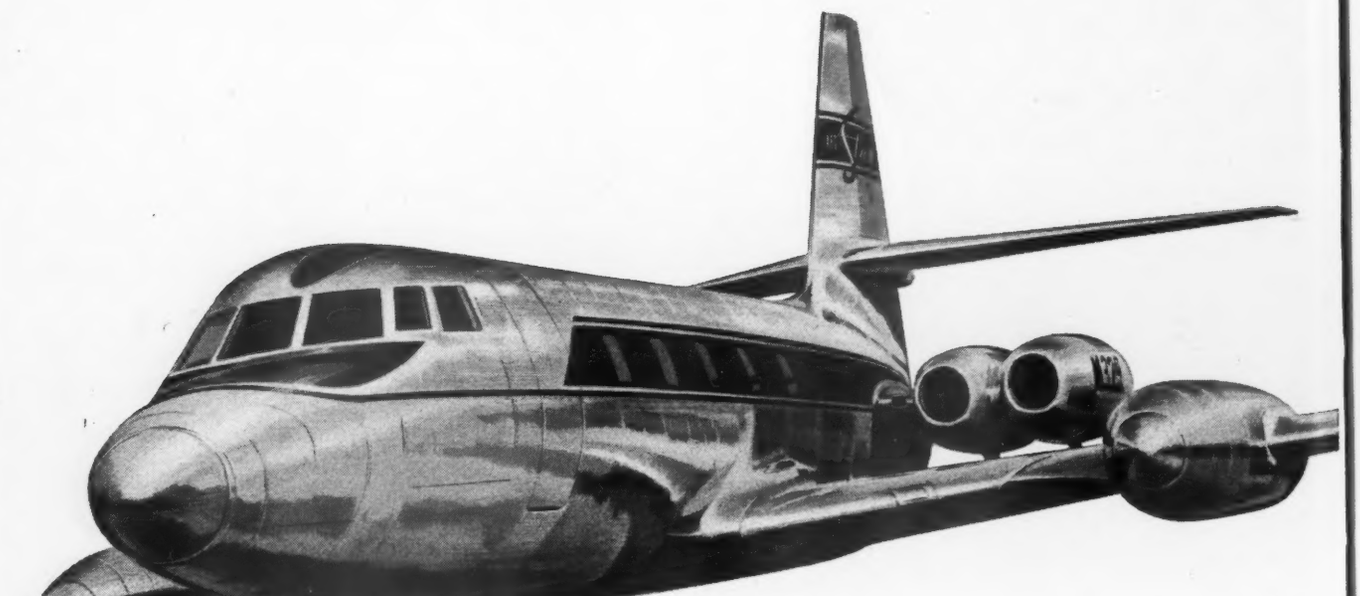

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Swedish troops stand on runway in Congo after airlift flight in Air Force C-130. Swedes were among first to respond following Congo crisis call to USAF July 14. Most other UN soldiers came from several African states.

Just unloaded from USAF C-124, jeeps line Leopoldville, Congo airfield. These vehicles were made available by US Army in Louisiana, painted with UN insignia before long transoceanic haul to Congo aboard Air Force planes.

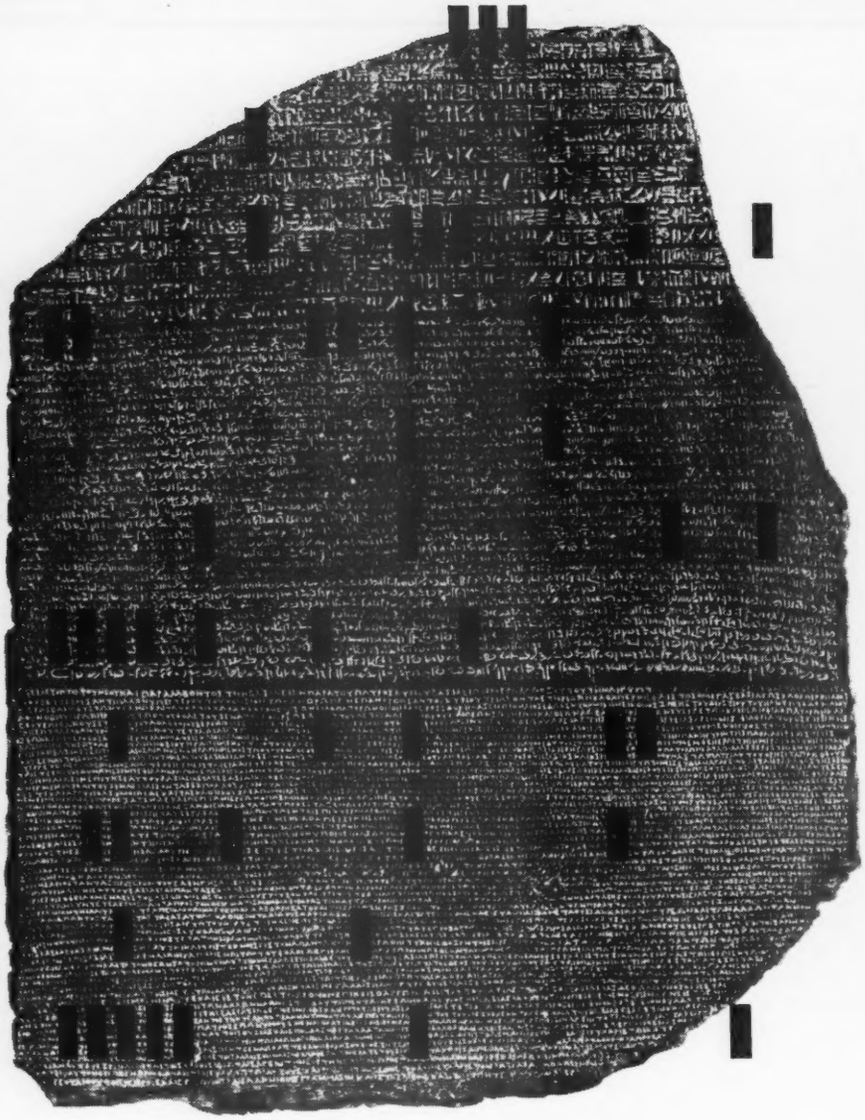
It is two years since I visited at SHAPE and the nearby US European Command. Since that visit NATO has moved into a new building in Paris, resplendent on the outside, sterile and efficient as a hospital on the inside. The kind of situation we have in the Congo—and there are others in addition to the Congo—appears to have resulted in a realization that a cold war is a war that has to be fought. The diplomats and the politicians are *not* fighting it, and the result is that men in uniform, who had no training in this area at West Point or Annapolis, are being forced to turn their attention to the arsenal of ideas in addition to the arsenal of weapons.

In NATO the effort is being led, apparently, by the West Germans. They have been rebuffed but are coming back again, determined to get some agreement on an offensive against Red ideology to replace the outworn policy of being forever on the defensive against Moscow's successful attacks. At SHAPE and the US unified command for Europe, top officers make no secret of their dissatisfaction with the way the cold war is progressing. Some of them feel that the military force is buying time for the cold-war warriors and that the latter have fallen flat on their faces in the trench. There are cold-war committees springing up within the military establishment. After all, we have got nearly a million people on this continent in the US military effort alone, and it should not take a gargantuan new bureaucracy to arm them with what is needed to offset the Russian effort. Mr. Khrushchev's constant reiteration that he is promoting peace and that we are warmongers is not being refuted. Our military forces, and their families, could do a lot to launch a new offensive in this area. Its importance is pointed up by the deep concern of the West Germans. They are in the front line.

If we turn to the more realistic first mission of SHAPE and NATO, which is to provide the sword and shield to protect western civilization, we find factors which have a bearing on the cold war (which is here) as well as the hot war (which threatens). The political heckling in Washington over the Military Assistance Program and our share of what it costs to maintain the peace in Europe with NATO doesn't do any good. The investment is a bargain. At USEUCOM headquarters there is a chart that shows the NATO defense expenditure has increased from $11.4 billion in 1955 to an estimated $14 billion in 1959. In the past decade European NATO nations have paid eighty-five percent of the cost of their defense establishments. For fiscal 1960 it is estimated they will pay ninety-five percent. This does not include the direct aid given by the US to the individual nations, a great deal of which is spent buying US weapons and support. The forces available to NATO today are four or five times greater than they were in 1950. The front that is held by these forces is just as important to the United States as were the British Isles in 1940 and 1941.

The hardware involved is getting more complex and expensive, just as it is for our own Army, Navy, and Air Force. IRBMs are operational in England and are being prepared for delivery to Italy and Turkey. More than thirty missile units have been delivered to the forces of ten NATO countries. Hawk and Sidewinder missiles will be produced in Europe. There is a requirement for other weapons, including a medium-range ballistic missile and a fighter with short takeoff and landing characteristics (STOL). One novel approach is that these systems could be complementary if the hardened missile sites were designed for a dual purpose. The additional job would be to serve as support points for the STOL fighters, equipped with fuel, weapons, and other single-sortie support at scattered points in Western Europe. There are sound, but classified, reasons why this kind of capability is essential.

It remains difficult to convince the average American that his contribution to these efforts, even if we provide the missile and design the STOL, make a contribution to his own security. The truth is that Western Europe is a prize. If it ever fell into Russian hands it would provide that country with an economic and manpower bonanza. It would be better than dozens of five-year plans out of the Kremlin that seek to marshal Russia's own skills and resources for the fight against freedom. It is significant that in Europe you can feel the intensity of the cold war in a way that is unknown in Wetumpka, Ala., or Bangor, Me. More important, it is not felt along Pennsylvania Avenue in Washington. The cold war is deadly serious, and the Soviet threat is growing. If the American Military Assistance Program is allowed to wane, both our European allies and the Russians will see it as a retreat in the cold war. The place to fight is in Europe, the Middle East, the Near East, and Africa, where our airlift is carrying out a campaign. The effort is not one that can be kept a diplomatic, cold-war secret. The effort is itself a weapon.—END



The Rosetta Stone unraveled secrets that had been buried for centuries. It bridged the gap between known civilization and unknown, ancient Egypt. The discovery of the Stone was an accident, one of those curious events that sometimes happen. ¶ Modern science faces a language problem much more complex than deciphering of hieroglyphics. And once again a Rosetta Stone is needed. But science cannot wait for an accidental discovery. ¶ Each branch of science has its own language which it uses to state problems. But electronic computers can solve problems only if they are posed in the language of the specific computer. Translating science languages into computer languages is enormously costly in time and money. UNCOL (Universal Computer Oriented Language) is a possible solution. The development of UNCOL will bridge the gap between a multitude of Problem Oriented Languages and an increasing number of Computer Languages. UNCOL is one task which occupies scientists at System Development Corporation. ¶ **SYSTEM DEVELOPMENT CORPORATION.** A non-profit scientific organization developing large-scale computer-based command and control systems. Staff openings at Lodi, New Jersey and Santa Monica, California.

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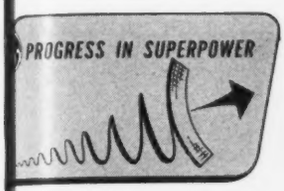

NEW

Superpower Microwave Tube Laboratory Established in General Electric Power Tube Department

WORK SCOPE INCLUDES APPLIED RESEARCH, ADVANCED DEVELOPMENT AND PRODUCT DESIGN FOR MICROWAVE TUBES PRODUCING RF ENERGY 100 TIMES GREATER THAN CONVENTIONAL TUBES

The General Electric Power Tube Department's new Superpower Microwave Tube Laboratory represents a significant step forward in the technological development of newer forms of radio-frequency energy generation. The Laboratory will continue work on multiple-beam klystrons and other tube types resulting from initial breakthroughs recently achieved by the scientists and engineers of G.E.'s Research Laboratory in the fields of linear-beam and cross-field devices. Based on these technological breakthroughs, the new Power Tube Department Laboratory has the capability of building r-f power sources in a single structure capable of developing CW power outputs in the order of thousands of kilowatts. This represents a dynamic departure in existing klystron technology which heretofore had been limited in practical applications to work with single-beam or combinations of single-beam devices.

With the advent of the new Laboratory, advances of similar magnitude are also predicted in such areas as cross-field power sources. Assumption of the Superpower Microwave Tube Laboratory by the General Electric Power Tube Department—from the Company's Research Laboratory—will facilitate the development of other functions required for marketing of products. Areas of immediate application in the development of new superpower energy sources are in the detection, location and communication with smaller and faster objects. In addition, new applications will undoubtedly include radio-astronomy, satellite space probe tracking, deep space command and communications systems. General Electric Power Tube Department, Schenectady 5, New York. 265-03-8481-31

EMINENT SCIENTISTS TO STAFF LABORATORY

Progress Is Our Most Important Product

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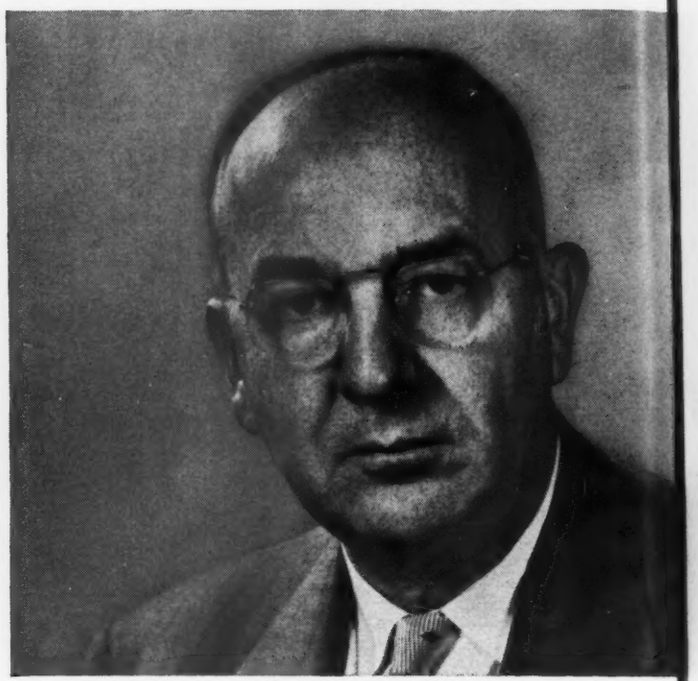
In order to focus more than 200 man-years of collective electronic experience on the further development of new radio-frequency power sources, General Electric's Power Tube Department has a nucleus of highly qualified electronic scientists and engineers drawn from the High-frequency Electronics Section of the General Electric Research Laboratory. They will operate the new Superpower Microwave Laboratory, and be supported by the continuing efforts of Research Laboratory personnel.

The average participation in electron tube activity of the personnel in the new laboratory is twenty years. Collectively, they have contributed to almost every type of electronic tube effort, with most emphasis in recent years in the linear-beam and cross-field areas, the two areas of greatest initial importance to the Superpower Microwave Tube Laboratory.



E. D. McARTHUR . . . Mr. McArthur has been named manager of the new Laboratory. Formerly manager of high-frequency electronics research of the G.E. Research Laboratory, he is noted as the inventor of the famous radar "lighthouse" planar triodes, first used during World War II. Mr. McArthur carried out early research and development on a wide variety of tubes, including high-power triodes, tetrodes, magnetrons, thyratrons and gas discharge tubes for a wide range of applications. He presently holds 64 patents for his work in the field of electronics.

THE SENIOR TECHNICAL STAFF . . .

DR. M. R. BOYD, project manager, traveling-wave multiple-beam klystrons

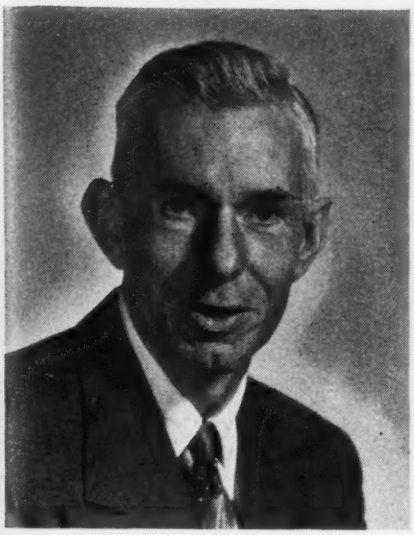
R. A. DEHN, consulting engineer

DR. P. N. HESS, project manager, cross-field amplifiers

J. S. HICKEY, project manager, resonant multiple-beam klystrons

Scientists to Staff New Superpower Microwave Tube Laboratory

LABORATORY MANAGEMENT . . .



R. J. BONDLEY . . . Mr. Bondley, an internationally known authority on the titanium hydride ceramic sealing process, which he developed and applied, will be manager of tube technology in the new General Electric Superpower Microwave Laboratory. His experience covers substantially the whole materials and methods field, including welding, brazing and vacuum technology. Much of his early work was on planar tubes and magnetrons.

Dr. D. A. WILBUR . . . Dr. Wilbur, manager of the supporting research operation, is co-discoverer of the basic principles of the voltage-tunable magnetron, and is noted for work on such developments as neutrode and unimode magnetrons. He is widely known for development of CW magnetrons for ECM, for which he received the Navy Certificate of Commendation in 1947. He is recognized as an international authority in cross-field interactions.

W. H. TEARE . . . Mr. Teare is manager of advanced engineering for the Laboratory. His background includes research and development work on nearly every type of electronic tube and vacuum device. In 1936 Mr. Teare received the General Electric Company's Coffin Award for his efforts in developing metal tubes. For the past several years he has been concerned with General Electric research in high-power klystrons.

. . . SUPPORTED BY

R. E. TURRENTINE, electronics engineer

DR. T. G. MIHRAN, G.E. Research Laboratory

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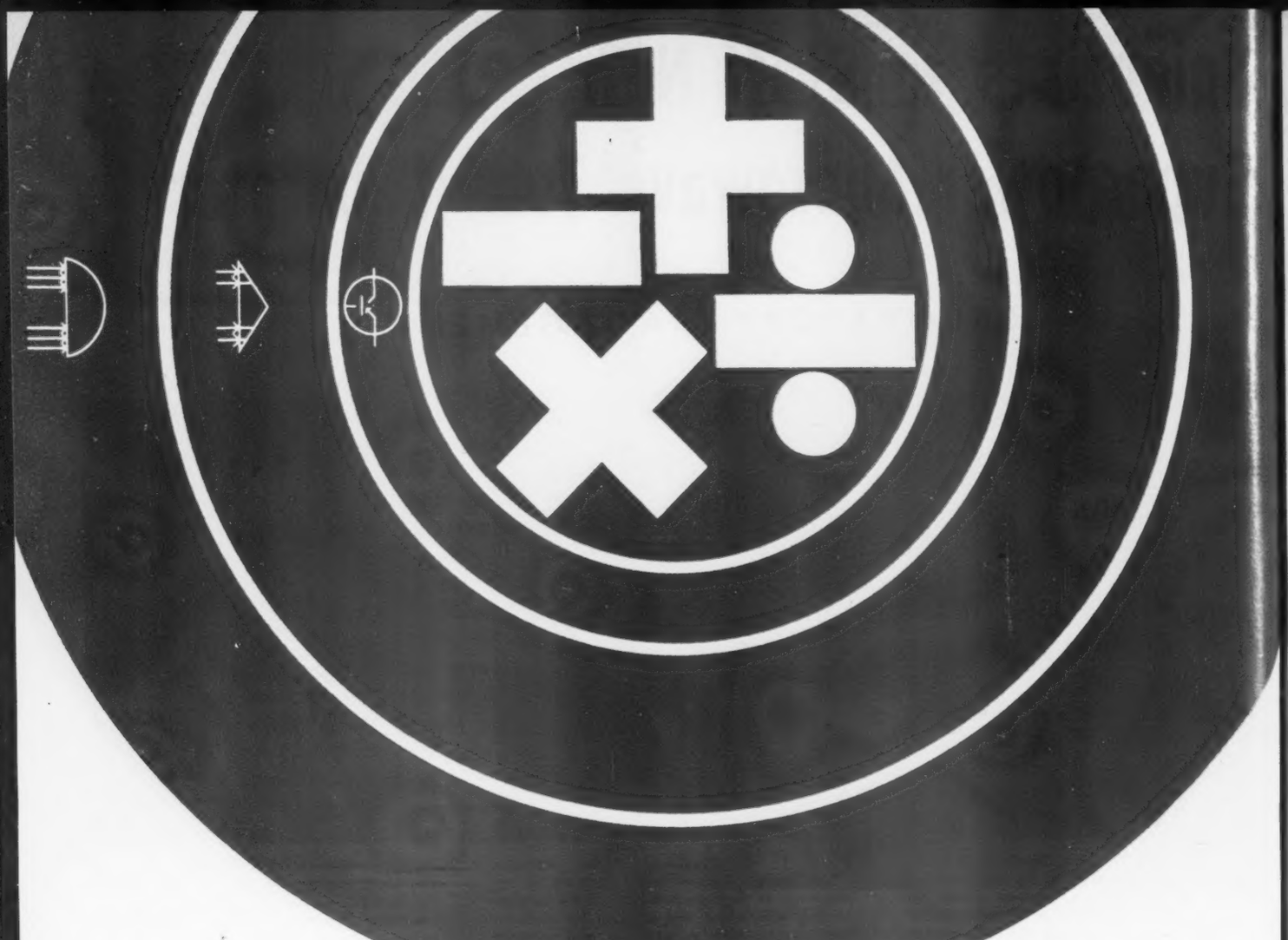

COMP'UTENCE

TOTAL COMPETENCE IN COMPUTATION AND DATA PROCESSING—THE BREADTH, THE BRAINS AND THE BACKGROUND

For instance, ALRI: USAF Airborne Long Range Input Program, one more demonstration of Comp'utence—and Burroughs Corporation—throughout the contract team program. **The objective:** a seaward, airborne extension of SAGE via radar-equipped reconnaissance aircraft, processing data in flight and transmitting it through ground receiving sites to central direction centers. **Total competence:** the way Burroughs Corporation, as System Manager, directs the integration of the special skills and facilities of its team*. **Total comp'utence:** the way Burroughs Corporation, also a team member, develops ALRI's miniaturized airborne data processors—reflections of its breadth (R & D through field service), brains (such as the Atlas guidance computers, data processing for Polaris) and background (75 years devoted to computation and data processing).

*Lockheed Aircraft Service, Inc.●Packard Bell Electronics Corporation●Philco Corporation●Military Electronic Computer Division of Burroughs Corporation●Electronic Communications, Inc.●GPL Division of General Precision, Inc. and●AC Spark Plug Division of General Motors Corporation.

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"NEW DIMENSIONS | in computation for military systems"

A SPECIAL REPORT

AIR FORCE
OCTOBER 1960

The Russians turned the U-2 'spy plane' back against us as a major propaganda weapon. In restrospect, five basic lessons for the free world stand out in an assessment of the U-2 incident and the subsequent Moscow show trial of US pilot Francis Gary Powers . . .

5 LESSONS FOR AMERICA

The Powers Trial and Its Aftermath

THE DUST is settling slowly on the U-2 incident and the subsequent Moscow trial of Francis Gary Powers. It becomes possible now to assess in some detail the implications of the whole affair. In the process of taking stock, America—and the entire free world—can learn five basic lessons about the nature of the continuing struggle with communism.

What have we been taught by the loss of our U-2 over Sverdlovsk on May 1? How can we relate the handling of Powers' case to other Kremlin moves? What were the Soviets trying to prove in the trial which opened August 17 and ended two days later?

From the outset, every Soviet maneuver relating to the incident was carefully planned and coordinated with other moves. To the Communists, all means of struggle are interrelated. In the Powers case, fanning hatred of the free world at home and discrediting the United States abroad were primary objectives.

Communists consider the United States, the strongest capitalist power, their principal enemy. But all non-Communist nations fall within the enemy camp. The Soviet leaders reason that if some of the smaller, newer nations can be deceived into believing the USSR is a peace-loving state, if they can be forced to surrender with a minimum of protest, all the better. Hence, care is taken to avoid too bellicose a posture. Under current circumstances, ultimate Soviet objectives of global conquest must be concealed at all cost.

Communist doctrine teaches that the struggle for global domination will be a protracted one. Until capitalism finally disappears from the world, any and all means of hastening its demise can and must be utilized, with military and nonmilitary conflict inte-

Sovfoto

U-2 pilot Francis Gary Powers at his August trial in the USSR. Young American received ten-year sentence for May 1 flight over Soviet Union. Kremlin handling of incident aimed to fan domestic hatred of free world, discredit US.

grated closely. Sometimes, such ruses as "peace" propaganda designed for foreign consumption can cause trouble at home, and occasionally it is necessary to remind the Soviet people that hatred of the West is their sacred patriotic duty.

When viewed against this perspective, Soviet handling of the U-2 case was neither unusual nor surprising.

The first lesson we can learn from the whole affair is this:

> The Kremlin leaders are using every means to discredit the United States and conceal the true nature of communism. Meanwhile, the Soviet population has been duly warned: "peaceful coexistence" tactics are intended solely for foreign consumption.

Insofar as the outside world was concerned, the Soviet conflict managers tried to exploit the U-2 overflight as proof that they had been right for years. Powers' capture furnished the most convincing "evidence" to date of purported US aggressive intent. Not only was US policy threatening the "peace-loving" Soviet Union, it was asserted once again, but all nations who favored "peace" promptly should join sides with the USSR, hastening thereby the collapse of the United States.

At home, the U-2 incident furnished an excuse for launching an intensive "anti-spy" campaign, a Kremlin move designed to eradicate some of the undesirable effects of earlier emphasis on "peaceful coexistence" tactics. US tourists, exchange students, and others were accused of espionage. Two members of our embassy staff—one the air attaché—were ousted; charges that US planes had buzzed Soviet ships in international waters were leveled, and the Soviet press, radio, and television hammered away at "vigilance" themes. The Soviet Air Force newspaper, for example, on August 19 carried a review of a book outlining so-called US espionage methods entitled *The Gangsters of Allen Dulles*. The book would be useful, said the reviewer, in educating the Soviet people and military to "a high spirit of vigilance." Of course, any mention whatsoever of Soviet espionage activities was scrupulously avoided.

The statements by Khrushchev and other top leaders, the coverage of the U-2 incident in the controlled Communist press and radio, the diplomatic notes sent to the free world, the exhibit of the plane's wreckage at Gorky Park in Moscow, the long and carefully documented indictment of Powers belatedly published in *Pravda* on July 7, and the testimony and cross-examination at the trial itself all emphasized the same basic points. Briefly, they were:

- In ordering the overflight, the "aggressive circles within the US leadership" had committed a new sin, proving once more their intentions to provoke war.
- Powers himself was simply a tool in the hands of bellicose politicians. It was they who were really on trial at the Hall of Columns. Chief Prosecutor Rudenko, whose past record of ordering ruthless executions in the Ukraine cast doubts on his attempts to behave like his counterpart in a US court, summed it up nicely:

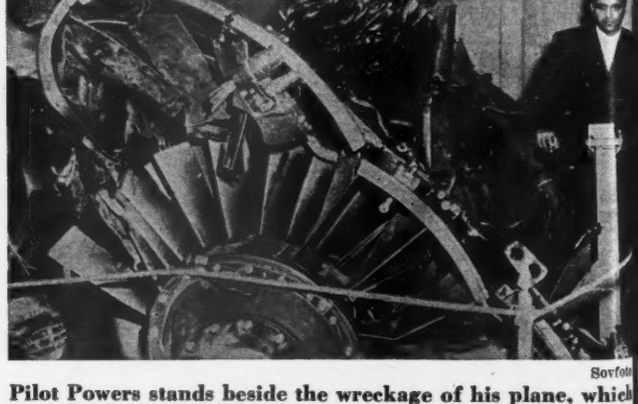
"The present trial," he said in his concluding speech August 19, ". . . fully reveals the criminal aggressive actions of US leading circles, the real instigators and organizers of the monstrous crimes directed against peace."

Moscow News proclaimed August 20 that "in the dock with Powers were those who had sent him on his espionage flight . . . above all those leading American politicians who had proclaimed espionage to be the state policy of the USA." This policy, the newspaper charged—erroneously—had been initiated in March 1948, and had received the official endorsement of the Congress of the United States in October 1951.

The third theme repeated over and over attempted to emphasize Soviet peaceful intentions. Despite serious US challenges to its "peace-loving" policy, the Soviets asserted, their camp was now so strong it could not be forced into war at the wrong moment. With exercise of sufficient vigilance, the people could expose all the spies in their midst.

The trial itself was designed to point up the alleged benevolent justice of the Soviet legal system. Powers was forced to testify that he had been treated nicely. The prosecution attempted to show its objective approach by examining the case in detail, even though the defendant pleaded guilty at the outset. Absent were the vitriolic accusations leveled in the same building against the more thoroughly brainwashed "Old Bolsheviks" during the bloody purge trials of the thirties. Nor was Powers required to recite a humiliating "confession" committed to memory during weeks of prison torture, a Communist tactic which had been applied freely against Korean War captives in efforts to "prove" charges of Western atrocities.

Even Powers' sentence was designed to demonstrate the "lenient understanding" of Soviet courts. The prosecution took pains to stress that a grave crime had been committed against the state. The maximum penalty was death. But Powers was merely a tool of opponents to "peaceful coexistence." Ten years' con-



Sovfoto

Pilot Powers stands beside the wreckage of his plane, which was displayed by Russians for extended period after it came down near Sverdlovsk in heart of the Soviet Union

finement would suffice as punishment, with the first three only to be spent in prison. Even then he would be allowed to receive generous packages of food and other supplies from his wife and family.

It should be recalled that, a few years ago, Soviet "justice" took quite a different approach to crime and punishment. Those charged with crimes against the state frequently were shot in the infamous tiled cells of Vorkuta without benefit of any trial whatsoever. Despite the switch in tactics shown by the Powers' case, Soviet concepts have not changed. Whatever best suits the interests of communism is "just"; whatever does not is "unjust."

The Kremlin conflict managers long have switched conveniently between brutality and subtlety, and show no signs of abandoning time-honored practices of selecting whatever tactics best suit their needs. The handling of Powers was relatively mild by Soviet standards. But wishful thinkers who conclude that the post-Stalin leadership has abandoned violence as a means of conflict should recall the three divisions of Soviet tank troops required to restore order in East Berlin after riots in June 1953. Force also checked the 1956 Hungarian revolt. While some purged Soviet leaders have suffered no more serious punishment than demotion, Beria and his alleged cohorts were tried secretly in December 1953 and then ruthlessly shot for their "crimes."

This point leads to the second lesson of the Powers trial:

> History repeats itself; there is little that is new in the Communist bag of tricks. Tactics are reshuffled as events require.

Khrushchev has admitted publicly that he knew about US flights over Soviet territory at the time of his meetings with President Eisenhower at Camp David, but refrained from discussing them. His disclosure, in a speech to the Supreme Soviet on May 5, that an earlier overflight on April 9 had been tracked, but not shot down, motivated some Western observers to speculate as to whether or not the Soviets were capable of hitting these earlier planes at their operating altitudes. While Powers testified at his trial that he had been hit "by something" at 68,000 feet, his father, speaking in New York, later voiced doubts that his son really believed the intercept had occurred at such an altitude.

Irrespective of the exact height at which Soviet antiaircraft weapons can zero in on a target, Khrushchev himself has said that constant improvement and modernization of all USSR military capabilities, offensive and defensive, continue to enjoy highest priority. A more likely answer to the timing of the U-2 incident can be found in Communist conflict requirements.

One of the cardinal principles is to update and reevaluate continuously global strategy, in order to exploit, whenever possible, any new event in the world which lends itself to Communist purposes.

A few examples will serve to illustrate how this principle operates. In August 1939 Stalin signed a pact of friendship and nonaggression with Hitler. A

Sovfoto

Evening session of trial in glittering Hall of Columns of Moscow's House of Unions. Defendant stands in dock at right. He was formally charged with "criminal responsibility for state crimes." Prosecutor sits at desk, left.

secret protocol to this treaty was brought to light when, in 1948, the US Department of State published a compilation of Nazi foreign office documents captured during the war. In return for remaining neutral in the forthcoming war Hitler was planning, the USSR would receive the right to take over, if it could, Eastern Poland, Estonia, Latvia, and Finland. Hitler later broke his agreement and invaded the USSR, and Stalin entered an alliance with the United States, Great Britain, and France. But after the war, Big Three insistence on free elections in Eastern Europe and a reunified Germany soon began to threaten Communist ability to hold on to the new territory it had gained.

US monopoly on the atomic bomb furnished the excuse for a vitriolic "Hate America" campaign, designed to turn the Communist masses against those whom they had been told earlier were their friends and comrades in arms. Concurrently, a "priority of Soviet science" campaign served to stir feelings of national pride and to spur the masses to cooperate with the Kremlin's race rapidly to catch up with US military technology.

Similarly, during the Korean War, Communist charges of alleged Western use of bacteriological weapons, as well as claims of atrocities against prisoners, were designed to serve several purposes. The campaign was complete with all the usual trimmings: exhibits, anti-US propaganda, lengthy "confessions" from captured Americans, detailed reports by all-Communist committees of legal "experts" and Communist-organized protest demonstrations. It was designed carefully to dovetail with other conflict tactics of the moment. In short, the Communists used BW-atrocity charges to help accomplish six objectives:

- To marshal international opinion behind a move to force the West to disarm;
- To divert the world's attention from the unwillingness of Communist prisoners to return to their homelands if an armistice were signed;

(Continued on following page)

A cartoon in the Soviet Army newspaper *Red Star* links US leadership to trial in rather sharp-penned caricatures. Overline translates as "The Verdict." Subject is labeled "Powers." Caption reads, "We flew, we flew . . . and we fell." Figures cowering under bench and seated pilot are Red versions of Vice President, US President, spy, militarist.

- To extricate a concession that Communist agitators could have an opportunity to "brain wash" the unwilling prisoners in a neutral zone *before* they were permitted to settle in the free world;
- To reinforce continuing efforts to condition the masses at home to hate the non-Communist world and all it represented;
- To furnish an excuse to prevent a Big Four summit meeting from taking place (preliminary talks on an agenda were in process in Paris when the BW campaign reached its height); and
- To intensify, momentarily, by skillfully combining the BW-atrocity charges with other political maneuvers, existing stresses and strains between the US and its European allies over the necessity to build up a strong military capability in Western Europe.

While Soviet handling of the U-2 incident has been somewhat more subtle, it, too, has been skillfully interwoven with other conflict tactics in a similar manner.

The third lesson we can learn from more recent events is this:

> Communist efforts to split our alliance system, and particularly, to deprive us of our overseas bases, continue unabated.

The Soviet disclosure that they had downed our U-2 signaled the beginning of an intensive campaign to stimulate fear among our allies of the consequences they would suffer should American planes continue to be granted basing privileges. Speaking in Moscow on May 30, Marshal Malinovsky warned:

> "As Minister of Defense of the Soviet Union, I have issued an order to the Commander in chief of missile troops to strike at the takeoff base of an aircraft if it violates the airspace of the Soviet Union. . . ."

Eventually, the scare campaign got somewhat out of hand. When the Soviets later shot down a US RB-47 over the Barents Sea on July 1, charging that it had violated Soviet frontiers, they did not retaliate against the base on British territory from which they claimed the plane had taken off. When queried at a press conference on July 12, a discomfited Khrushchev stated vaguely that the RB-47 crew had committed a "different crime." Malinovsky's threat still applied, he said, but this flight had been intercepted soon after it entered Soviet airspace. Under the circumstances, he argued, shooting down the plane had sufficed as retaliation.

When the UN heard the charges, Henry Cabot Lodge said the US had technical evidence that the RB-47 never had violated Soviet territorial waters. The Soviets rejected Lodge's argument, but failed to prove him wrong. They refused to permit an impartial investigation. Meanwhile, their diplomatic notes to our allies and verbal threats from Khrushchev and others continued to warn of dire consequences—Soviet missile retaliation—if our planes retained base rights overseas.

The Soviet threats have proved ineffective. But no one should be surprised—or intimidated—if the Communists should dust off another trick in the next few months as part of a renewed effort to deprive us of overseas bases freely granted and legally agreed upon.

The timing of the U-2 incident and the later attempt to drive an RB-47 toward the Soviet border also can be related to a concerted effort to conceal information on Soviet missile deployment. This is lesson number four of the Powers' case:

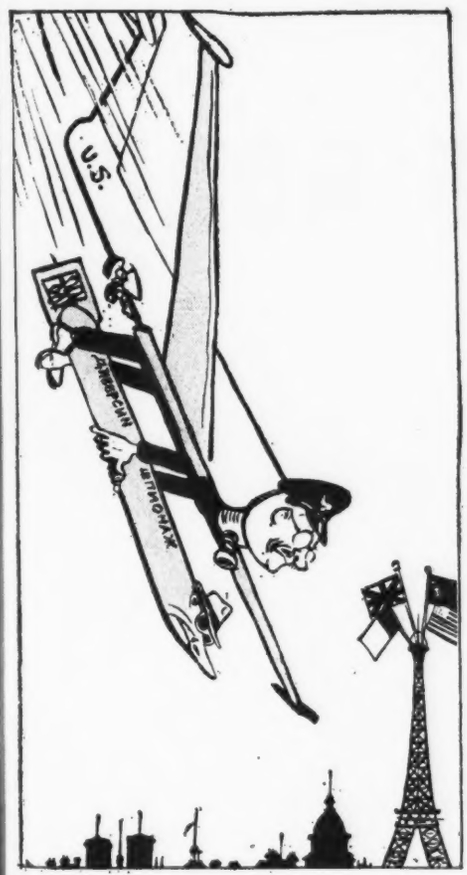
> The Soviets are attempting, at all costs, to withhold from us information about their long-range missile striking force.

Some optimists have claimed that Premier Khrushchev is bluffing about Soviet ICBM capabilities. If he is bluffing, why has he risked so many setbacks to his "peaceful coexistence" campaign, which had been working so smoothly, to extract from President Eisenhower a promise that no more overflights of Soviet territory would occur while he remains in office? Why did the Soviets attempt to force our RB-47 to commit another violation, despite the President's assurances? Having failed, why did they shoot down our plane over international waters?

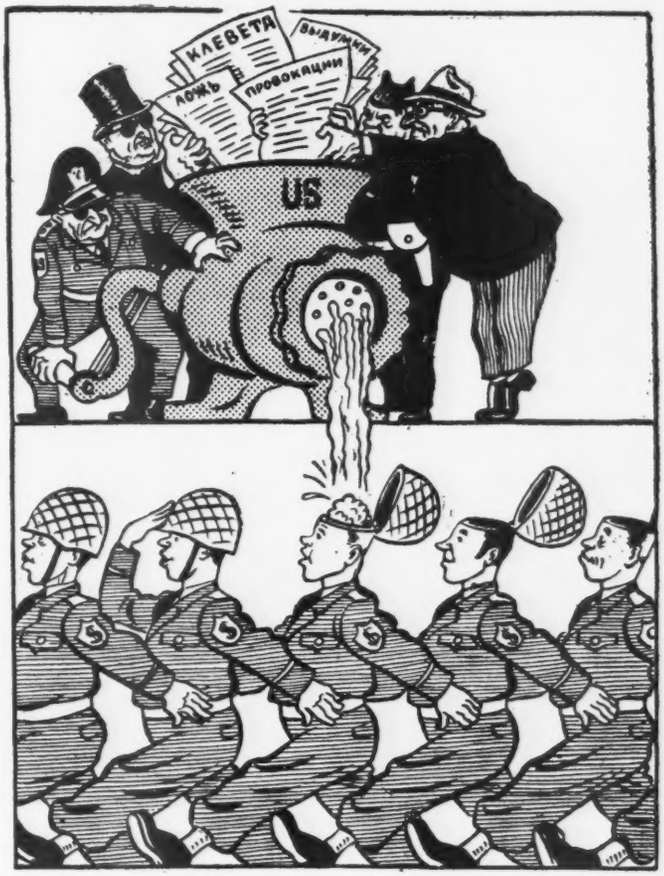
If the USSR does not intend aggression, why are its leaders showing definite signs of nervousness about what we may know about their long-range striking force? Why are they resorting to acts of desperation like the current anti-spy campaign? Why did Khrushchev take pains to reassure the comrades at Bucharest on June 21 that US overflights had not succeeded in photographing operational Soviet missile sites?

Cunning as they have proved to be on occasion, this time the Soviets have tipped their hand a bit. When it is time to attack the United States, the USSR

Izvestia **cartoons were headed "Champions not appearing at the Olympics." First, Western diplomat runs in place bearing paper labeled, "First control, then disarmament." Second, CIA head Allen Dulles ready to shotput figure marked "U-2" taken from bin reading "Spies." Third, Secretary of State Herter falls while carrying briefcase of "State Department Policy." Fourth, West German Chancellor Adenauer, friend run with missile marked, "Atomic equipment of the Bundeswehr." Fifth, dollar-denoted cuff supports gymnast with sign, "I am President Tshombe," pro-West Congo leader.**



Right, Red Air Force organ *Soviet Aviation* depicts what it calls "filling station system" indoctrination by which US servicemen are taught to feel "animosity and hatred" toward the peoples of the Soviet Union to prepare them for aggression against the "socialist camp."



Left, Russian humor magazine *Krokodil* shows U-2 "spy plane" carrying an "espionage torpedo" that blows up the summit meeting in Paris. The caption under cartoon asked Russian readers, "Who spoiled the summit conference?" Answer was simply, "The US."

will have to absorb nuclear retaliation. The Kremlin leaders are aware of this, and concealing all preparations for an attack, thereby attempting to reduce the amount of warning we have, is a matter of highest and most urgent priority.

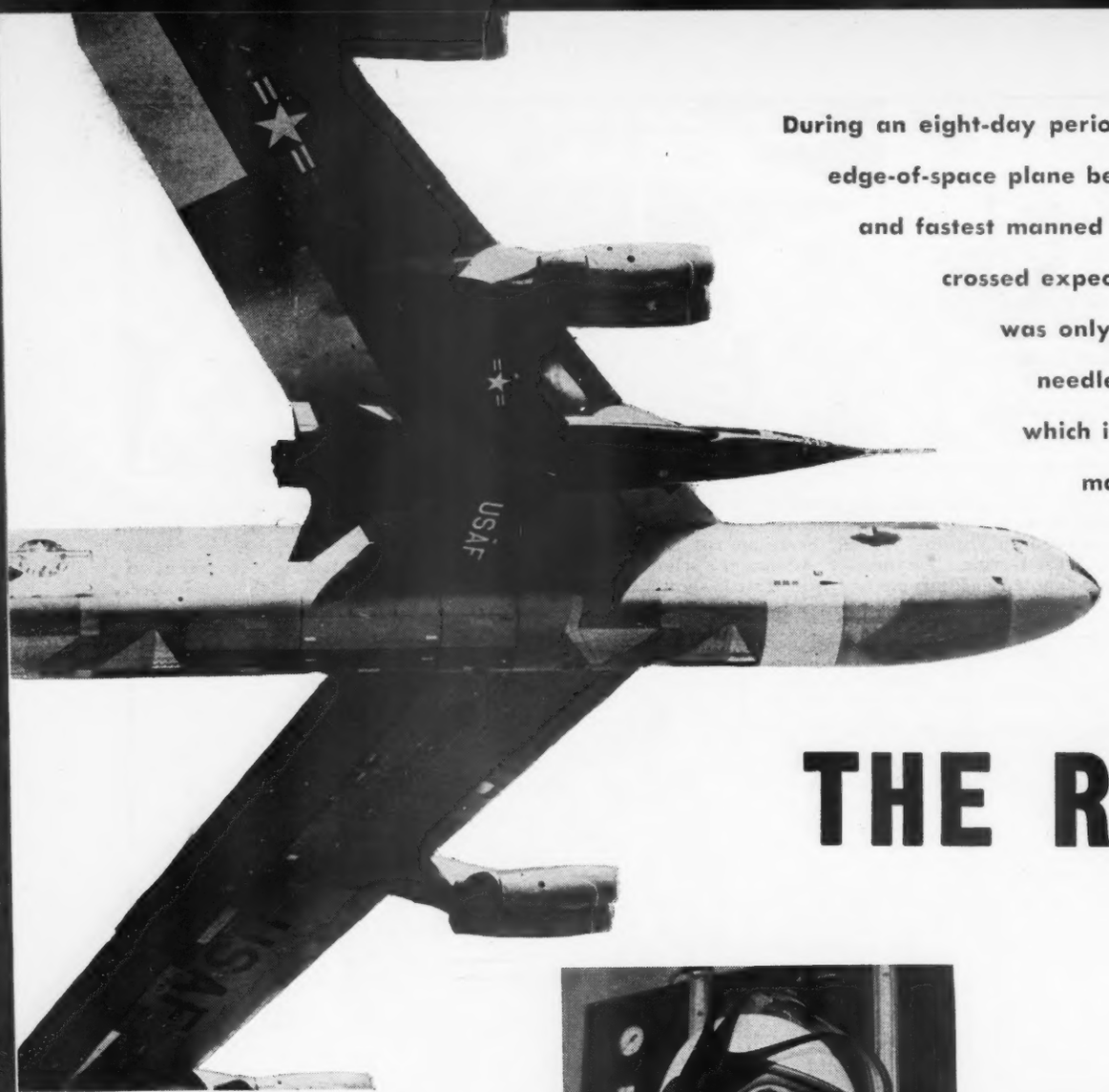
The fifth lesson we can learn from the Powers trial summarizes the across-the-board challenges communism is posing to our national interests and the interests of the free world. It is simply this:

> The sooner we understand the integrated Soviet approach to conflict, the more quickly we will learn to view all moves as parts of a coordinated strategy of aggressive struggle for world dominiation.

Once we understand our enemy and how he operates, we will accept the fact that, irrespective of the tactics being granted priority at the moment, communism has not changed. Then, the battle will be partially won. Ensuring victory will become a matter of refusing to succumb to continuing attempts to intimidate us. The only language the Communists understand is the language of power. Maintaining clear-cut military superiority indefinitely, plus hard-headed refusal to back down on any issue, is the only way to prevent World War III.—END

During an eight-day period in August, the X-15 edge-of-space plane became history's highest and fastest manned vehicle. The fingers-crossed expectation now is that this was only the beginning for the needle-nosed research craft, which is designed to propel mankind a good distance along . . .

THE ROAD



Above, B-52 mother plane bears the needle-nosed X-15 into the air for launch in historic current series of tests. To date, these have put new altitude, speed records for manned vehicles into the books. Right, Air Force Maj. Bob White, who was at controls of edge-of-space craft when it set the altitude mark on August 12. Speed mark fell eight days earlier.

Jules V. Bergman

TIME: 8:46 a.m. Pacific Daylight. Date: August 12, 1960. Place: 45,000 feet over the trackless wastes of the California-Nevada divide. Sealed in the cockpit of the X-15 rocket plane, Maj. Robert White, USAF project pilot on the X-15 program, crouches forward ticking off the final items on his countdown checkoff list. In the B-52 carrying the X-15 under its right wing, Maj. Fitzhugh A. Fulton, piloting the eight-jet mother ship, reaches the last item on his countdown.

"Ready to go, Bob?" he intones into his lip mike. "Any time," Bob White answers. The long, agonizing countdown is nearly over. White flicks a switch on his cockpit panel and the red launch light comes on in the B-52 cockpit.

"Starting count," Fulton says. "Five . . . four . . . three . . . two . . . one . . . drop!" A dull distant clunk is the only sound as the X-15 falls from the bomber's wing as it cruises at nearly 475 knots. "Clean break," the launch panel operator, back in the B-52's belly, shouts. The time: 8:48 a.m. PDT.

White waits a split second, then triggers the toggle switches firing up all eight barrels of his two XLR-11 rocket engines. A burst of rocket flames shatters the crystal-clear void as the engines ignite. Then, with staggering swiftness, the X-15 leaps forward hungrily. White's altimeter reads 40,000 feet; he has fallen nearly a mile in starting up. Above him, the B-52 has turned out of his way. The machmeter in the X-15 shoots through Mach 1 as if it never existed; for this bird it doesn't. White climbs to 60,000 feet, levels off for about one minute as he builds a surge of speed to

1,700 mph, then, burning on all eight rockets, points the X-15 toward the heavens.

The manned rocket plane streaks upward, casually leaving behind it in scant seconds the altitude marks of two decades. Far ahead and below, at Edwards AFB, USAF's Flight Test Center, radars reach up to track him after the chase planes lose the X-15.

As White touches his peak speed, two and a half Gs of acceleration force crush him back into the man-shaped seat of the X-15. But now, as he soars toward the top of his Keplerian arc, the acceleration forces begin to fade. Back and forth go the brief words of flight data as Bob White relays speed and altitude figures. He streaks past the last remaining record—the 126,200-foot mark set by the late Capt. Iven Kincheloe, Jr., in the X-2 four years earlier.

Climbing past 130,000 feet, Bob White feels his speed falling off. His rockets have long since burned out, their fuel expended in a four-minute energy climax that has shot him far beyond the stratosphere. Now he "milks" the plane for all the altitude he feels it can safely achieve. At 131,000 feet, White goes over

to BEYOND

the hump and starts back down, weightless for nearly a full minute.

White has exceeded the X-2 by nearly a mile, or so he thinks. But the instrumentation data betters his record: He has reached 136,500 feet, nearly twenty-six miles into the void of near space.

Peering out from the X-15's slitlike cockpit windows, Bob White perceives a world unseen by any other man. "Three distinct bands—the earth, the light blue of the sky, and then the very deep blue of extreme altitude" loom upward and around him. "It's fantastic," White declares.

Soaring downward to Edwards, he levels off at 52,000 feet, then makes ready for a 200-knot landing on Rogers Dry Lake at the Flight Test Center. The total elapsed time, from takeoff of the B-52 to landing of the X-15, clocks out at fifty-four minutes. The X-15 itself flew for just eleven minutes.

Eight days earlier, the X-15 had smashed the world's speed record, as veteran rocket pilot Joe Walker, X-15 project pilot for the National Aeronautics and Space Administration, crashed through to 2,196 mph, topping the old mark of 2,094 mph set in 1956 by the late Capt. Milburn G. Apt in the last flight of the X-2. In eight days, the X-15 has taken both speed and altitude marks; the X-15 now can only top itself as it reaches out faster and higher.

And this is just the beginning: White and Walker set their records with the scanty 16,000 pounds of power provided by the twin XLR-11 rockets (originally designed for the X-1 program). In the months and years ahead, with the 50,000-pound XLR (for Experimental Liquid Rocket) 99 engine—most powerful manned-rocket power plant in the world installed in the bird—the records should fall almost routinely.

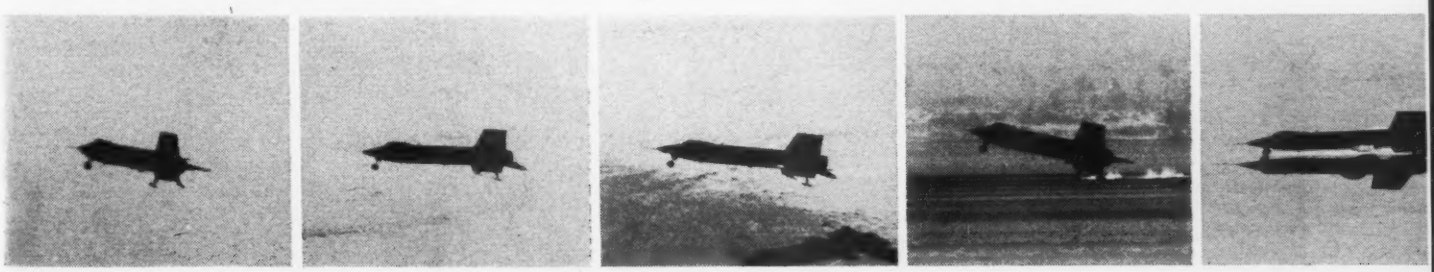
Joe Walker will aim at working the X-15 up as fast as it will safely go—perhaps to 4,500 mph, Mach 7. Bob White will aim to fly literally out of this world—to beyond 250,000 feet if all goes right—nearly fifty miles, and possibly even higher. No other piloted aircraft should come close to the X-15 as it takes man out of his atmosphere and back to earth, in a series of fabulous flights blazing the trail for Dyna-Soar and later piloted orbital vehicles.

Latest in the proud line of USAF experimental research aircraft, the X-15 had its beginnings eight years ago when scientists of the old National Advisory Committee for Aeronautics (NACA), predecessor of NASA, projected the X-1 and the X-2 (which had just begun flying), into the future. NACA laboratories began studying the problems of piloted spaceflight; two years later they came up with the characteristics of the X-15 and with USAF and Navy worked up what has developed into one of the nation's outstanding examples of interservice and interagency cooperation. NACA would supply technical direction; USAF most of the funding and project leadership; Navy aided in funding, research, and testing.

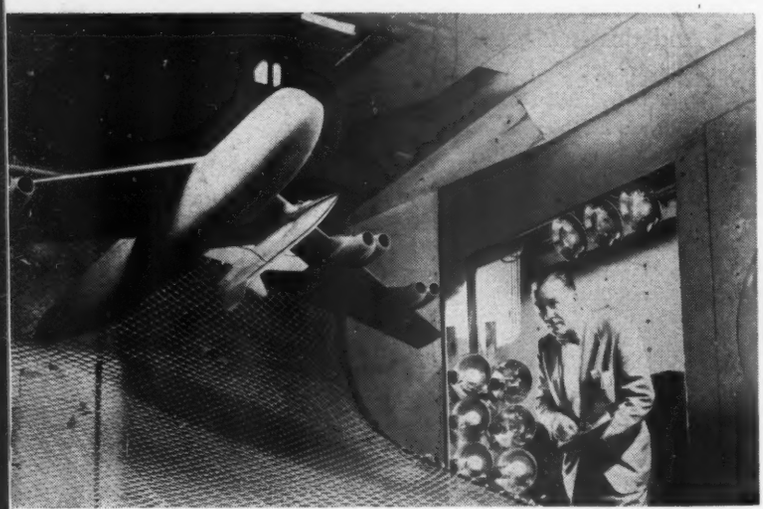
After a fast and furious competition between Bell, North American, Republic, and Douglas for the challenge of building the new research vehicle, North American was given the go-ahead to build three X-15s in December of 1955. But there was far more to it than building three airplanes: In a single sweep man was biting off more speed and altitude than ever had been dreamed of.

The X-2 had not yet penetrated 2,000 mph; some doubted it could. The faster you went the worse became the controllability problem, that pilot-killing never-never land where few had dared to tread. And beyond Mach 3, fuselage heating literally threatened to first twist, then melt airplanes. Battling both problems, NAA, NACA, and USAF scientists and engineers ran a series of different models through no less than twelve different wind tunnels until they felt the X-15's unique system of conventional aerodynamic and reac-

(Continued on following page)



Left to right, X-15 comes in for a landing following test flight. Three pilots have handled the revolutionary plane in series—North American's Scott Crossfield, NASA's Joe Walker, Major White. Walker set new speed record.



Wind-tunnel view of the X-15 in concept stage. In many ways, the North American plane is playing a pioneer role at this point in history. Next comes the Dyna-Soar craft.

tion jet controls could take it out of and back into the earth's atmosphere safely. Inconel-X, a space-age alloy of nickel and stainless steel, capable of standing up to 1,200 degrees F, was chosen for the skin of the new bird.

The death of USAF Capt. Mel Apt in 1956 in the record-shattering last flight of the X-2, which came just before construction started on the X-15, offered further proof of the necessity for a good pilot survival system. The MC-2 pressure suit, made of heat-resistant armor plate of aluminized nylon, was designed to provide pressure and oxygen to the pilots even if they had to eject at extreme altitudes. The specially designed rocket-powered ejection seat, with stabilizing fins and booms, was tested over and over again on the rocket sled test track at Edwards until the engineers were sure it would get an X-15 pilot safely out of a crippled plane and stop him from tumbling or spinning through space under the majority of the conditions the X-15 will experience.

In September of 1957, North American began building the three X-15 rocket planes. Even before construction began, the three engineering test pilots who had been chosen to fly the ship were contributing. Scott Crossfield, who had left NACA and joined North American smack at the onset of the program, was a veteran of experimental rocket flying, as was Joe Walker, who would be the primary NASA pilot. The late USAF Capt. Iven Kincheloe had already been chosen by USAF as its X-15 project pilot. The three, having flown all of our rocket-powered planes, the X-1, X-2, and D-558-II, as well as many other experimental research planes, could work alongside designers and engineers and come up with the pilot's view.

These were the first of a new breed, the combined aeronautical engineer-test pilot, with the unique talent and ability of being able to come back from a flight and report in precise scientific terms just *what* didn't work right. Crossfield would handle the contractor's demonstration flights, then turn the ships over to Walker and Kincheloe for high-performance testing.

The X-15 was to be a labor of love all the way: Rocket-and-experimental flying veterans, an elite corps scattered over the nation, found their way to the program. USAF's Maj. Arthur "Kit" Murray, who'd set the old 94,000-foot altitude record in the X-1, became Weapons System Project Officer for USAF, based at Wright-Patterson AFB. The WSPO concept, brand new with USAF in the X-15, aimed and beautifully

X-15's three jockeys—Walker, Crossfield, and White in the usual order—stand beside it in recent photograph. There are actually three X-15s. One has been delivered by North American for NASA-Air Force flight test program.

A successful supersonic ejection of fully attired dummy from X-15 sled run at Edwards. Stabilizing fins on seat, other features eliminated dangerous tumbling in ejecting from high-speed vehicle, contributed to testing safety.

succeeded at eliminating confusion, red tape, and divided authority by having one office tie all the loose ends together.

Q. C. Harvey, North American's X-15 Flight Test Chief, is a hardy holdover of the Bell rocket planes. The X-15 hangars at Edwards are the secret refuge of the dedicated specialists who have watched and worked on the X planes, from the original X-1 on up. They have watched, and cried, and cheered as they witnessed success and failure and progress in the blistering 110-degree heat of the Mojave summer and in the bone-chilling predawn cold of the winters. To them, what they do is not a job, it is a way of life; and development of each new untried experimental vehicle is for them like raising a child.

The pilots at Edwards, now highly trained and educated graduates of USAF's Flight Test Pilots School on the base, fly more securely knowing the painstaking skill of the men on the ground. When Bob White, then a captain and X-15 backup pilot, took over after Iven Kincheloe's untimely death escaping from a crippled F-104, the Edwards crew joined behind White. The X-15 was nearly ready to be rolled out up at North American's Los Angeles plant.

White, a tall, restless thirty-six-year-old World War II and Korean fighter pilot, was the least experienced of the X-15 crew. He had never flown rockets before. But after graduating in 1954 from the Flight Test Pilots School he worked over various phase-testing of the F-86, F-89, F-102, and F-105, and the VTOL X-13.

Ruggedly handsome, Bob White has a face cast in a permanently youthful and enduring mold. Like most

(Continued on following page)

A closer look at the test sled and dummy in place prior to ejection demonstration above. X-2 pilot Capt. Milburn G. Apt died in tail-over-nose tumble of escape capsule after his X-2 set speed record, went out of control in 1956.

Here, the two X-2 rocket plane pilots, both deceased. Standing, Capt. Iven C. Kincheloe, altitude record setter who died in F-104 crash. In cockpit, Captain Apt. The X-2 contributed much knowledge, information for the later X-15.

of the new breed, he flies for love, yet in a businesslike fashion. His mind thinks in the brief, corrected staccato inputs demanded by computers—the jagged pieces of data that make up human instrumentation—the uniquely-manlike-yet-suggestive-of-machine capability of the space-age pilot.

After the X-15's rollout, White, along with Crossfield and Walker, began practice-flying X-15 missions before the rocket plane itself was ready. Using F-100s and F-104s, they flew "dirty configurations"—with engine throttled back, dive brakes popped, tail chutes open, and nose way down—simulating the X-15's high rate of sink-landing habits. At the same time, they commuted south to Los Angeles to get in "simulator time" in an X-15 cockpit rigged to computers at the North American plant. Before Bob White ever handled the X-15 in the air, he'd "flown" hundreds of missions, building experience at controlling the manned missile under the worst possible conditions.

Six months elapsed after the X-15's delivery to Edwards in October 1958 before it was ready for its first captive flights, slung under the mother B-52's wing. On June 8, 1959, after four captive tests, Scott Crossfield made the first glide flight and successful landing. The second X-15, which had arrived at Edwards in April, was captive-flown with a full fuel load on July 24. All went well, but one week later, on the ground, it was damaged by an explosion as the crew purged its fuel lines.

Plans went ahead nevertheless for the first powered flight of number-two X-15 and, on September 17, Crossfield successfully flew it with Bob White as chase pilot in an F-104. A second powered flight went smoothly, but on the third mission with power, an engine fire broke out as Crossfield ignited his rockets and, in an emergency landing on Rosamond Dry Lake, the X-15 broke in half behind the cockpit.

X-15, B-52 on Edwards runway. Altitude, speed records set by rocket plane in August are not in same category as USAF "highest-and-fastest" marks set in operational jets last December since the X-15 is air-launched vehicle.

In Edwards ground control center during X-15 test flight. Experimental X-15 is just coming into its own. New, high-powered engine will make a vast difference. The record-shattering performances thus far should be overshadowed.

The flight test program was held up while all three X-15s were beefed-up. Finally, in February of 1960, the first X-15 was turned over to the Joint Operating Committee (JOC) of USAF and NASA, which together would run the high-performance testing. The big XLR-99 engine was still not ready; Walker and Bob White would test out the rocket plane first with the two smaller XLR-11 engines.

Late in March, Joe Walker made the first JOC flight in the X-15, climbing to 48,500 feet and reaching Mach 2. On April 13, Bob White made his first X-15 flight, achieving 48,000 feet and Mach 1.9. It was no trick; the trick was to hold back. Even with the small engines, the rocket plane was capable of far higher speeds and altitudes. Into the spring and early summer, the flights went forward, as Walker and White worked upward, extending the "speed and altitude envelopes" of the plane. On May 12, Walker exceeded Mach 3; one week later, May 19, Bob White went up to 107,000 feet, flying the number-one X-15.

The big XLR-99 engine, meantime, had arrived at Edwards and, after it was installed in number-three X-15, Crossfield and North American went ahead with plans for the first flight. But on the second ground runup, an explosion shook the plane; it blew in two, with Crossfield in the cockpit, and the nose section was hurled forward of the main section of the fuselage. Miraculously, Crossfield escaped injury in the blast and fire, which was traced to fuel-line leakage. But the X-15 suffered major damage, and the flight program was set back while a new engine was installed in one of the two remaining undamaged rocket planes.

Despite the setback, Walker and White kept right on flying the X-15 with the smaller engine, climbing the peak until they had gone as high and as fast as it would take the X-15. In September, the XLR-99 was ready to go, set to begin taking the X-15 even higher.

In his small green office in Flight Test Ops at Edwards, Bob White goes over the engineering data and plans his flights with the quiet precision of a man who knows he is taking a volatile machine and a fragile man far above where other humans can do much to help him. At the next desk over is Capt. Bob Rushworth, White's backup pilot on the X-15 project. Against one wall is a foldup three-part cardboard photographic mockup of the X-15's cockpit layout. Every instrument, each switch, has been etched into their minds. This is thinking time; in the air, there are only split seconds for deciding what to do. The first move has to be the right one.

The danger? "Sure, flying the X-15's dangerous," White says quietly and slowly, "but the same element of risk is in a lot of jet flying. With the X-15 we'll build knowledge about aerodynamic heating, about control at extreme altitudes, about exit and reentry to and from the earth . . . about weightlessness, and how pilots react to this kind of flying. The pilots can and will adapt to any and all conditions they have to . . . instruments lack this talent."

Capable and cool, ready to fly in or out of the atmosphere, Bob White is a symbol of the new breed of aerospace pilot, set to head for space not in a missile, but in an airplane *he* commands. Just as man had conquered the wildernesses of new continents and unknown oceans, so he would take himself into space and bring himself back. Guided by a chain of developments that began with the first fabric and wood airplanes, and went forward into X-1 and X-2, he would carry on with X-15, Dyna-Soar, and beyond.—END

The author, Jules V. Bergman, is a pilot and aviation-space-science reporter for the American Broadcasting Company. He is the author of two forthcoming books—one on the X-15 entitled Ninety Seconds to Space—the X-15 Story, *and the other on learning to fly.*

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President Charles de Gaulle faces a painful decision in the area of French missile development. Should he try to produce a costly home-grown ballistic delivery system for the nation's new nuclear capability, itself not yet in the "packaged" stage? This issue is not a simple one . . .

President de Gaulle AND THE DILEMMA of the FRENCH

Murray Green

TWO NUCLEAR blasts in the Sahara Desert some months ago loudly proclaimed Charles de Gaulle's presence at the door to the world's most exclusive club. But he knew that his credentials were outdated.

To be fully accredited in this nuclear age it is necessary, first, that de Gaulle reduce his device to compact size to permit its packaging as a weapon; and, second, that he produce a suitable vehicle to deliver it.

Without outside help, France cannot, at least for several years, claim a reliable delivery vehicle. Knowing this, President de Gaulle welcomes a disarmament that gives priority attention to suspension or control of vehicle testing where France has no present capability. He is less enthused over other proposals only to cease nuclear weapon testing, an area where France, given enough time, has a chance to catch up.

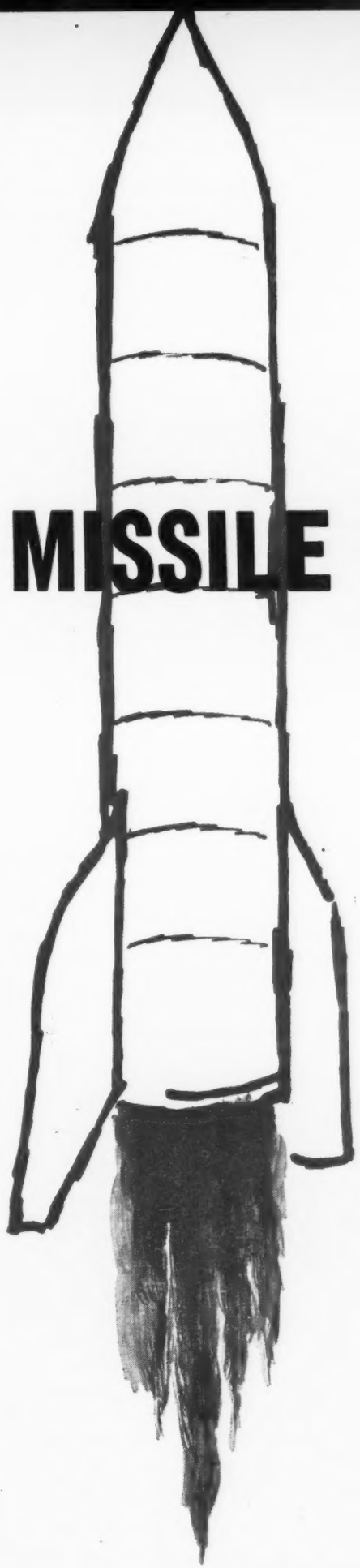
Doubtlessly, these thoughts were on the French leader's mind when he visited America in April and recorded his views on disarmament.

"It seems to me," President de Gaulle told the National Press Club in Washington, "that the effort to reach a *détente* should focus on nuclear weapons and that they should, for the moment, be limited to reciprocal controls of rockets, strategic aircraft, and ships capable of carrying nuclear bombs to all corners of the world. Control of these vehicles and control of the bases from which they can be launched—this is a question on which I think it is still possible to do something practical."

This view does not sit well with the other Western powers, although disagreement may now be nominal in Britain which has scratched its lone entry in the ballistic-missile sweepstakes. On disarmament the United States strongly favors supervision of the nuclear warheads themselves. Nikita Khrushchev, who has proclaimed Russia's exclusive dependence upon missiles and rockets, authorized the submission to the Geneva Disarmament Commission in June 1960 of a "first-stage" proposal to eliminate nuclear weapons "and all means of delivering such weapons," including rockets and missiles. There was a string attached to it. He made elimination of all foreign military bases a condition for disarmament. Obviously, this package would necessitate disbanding NATO. Its unacceptability, however, did not prevent Valerian Zorin, the chief Soviet delegate in Geneva, from reminding the French delegation that Moscow's new plan embraces the French suggestion for wiping out all means of delivery of nuclear weapons.

President de Gaulle has not returned the embrace, for he well understands the motivations behind it and the impossibility of its acceptance. He has not lessened the French effort to attain parity in the weapons delivery field. A little over a year ago, on July 1, 1959, the *Societé d'Etudes et de Récherchés sur les Engins Balistiques* was formed with one objective—to perfect an operational ballistic missile. SEREB is a nationalized company serving as prime management contractor. It has been joined by other selected firms that are making additional capital contributions to speed up priority research.

The developmental SSBS (*Sol-Sol Balistique-Strategique*), a 1,500-mile IRBM, is a matter of pride for France. The United Kingdom, which faced the same problem of developing a ballistic missile, recently abandoned Blue Streak. It was a characteristically practical decision based on a preliminary expenditure of $200 million, an expectation that billions more



MISSILE PROGRAM

would be needed to complete it, and some rising doubts that a fixed-base missile system could really defend Britain.

The Fifth Republic is not necessarily moved by the same pragmatic considerations. The Frenchman's attitude toward national defense is inseparable from his acceptance of *Vérité et Sévérité*, the policy of austerity which places at the end of the rainbow de Gaulle's "Grand Design." The nuclear explosions represent two firm steps in the direction of reclaiming France's rightful place among the world's ranking powers.

It is clear that the French intend to bring their own ballistic missile to fruition, preferably through the same kind of assistance we afforded the British, or by their own resources, if necessary. They would like, but have not yet received, atomic energy information under the McMahon Act, and ballistic missile data and hardware as President Eisenhower and Prime Minister Macmillan, meeting in Bermuda in 1958, agreed the British should have.

No French government, least of all one led by the living embodiment of French nationalism, could renounce its ambition to become a ranking nation with the perquisites of power that go with it. To pressure American acceptance of these aims, de Gaulle withdrew his Mediterranean fleet from control of General Norstad (SACEUR), and he insisted upon controlling all American nuclear warheads on French soil. As a result, the US withdrew certain air units from France and revised plans to base IRBMs there.

Internal pressure has been applied consistent with this goal. Within the French Air Ministry, stability

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has been brought to the DTIA *(Direction Technique et Industrielle de l'Aeronautique)*, which is supervising the development of the SSBS ballistic missile. This project is just one of a number embraced in the "Loi Programme," a five-year plan of research and development to bring important missile and aircraft projects into operation.

It may not be widely known, but the French SS-10 antitank missile is the very best of its kind. It is, in fact, so superior to anything produced in the United States that the US Army and US Marine Corps have contracted to purchase several thousands. The SS-10 is the first complete weapon system of foreign design and manufacture to be bought in quantities by the United States in years. Moreover, Nord Aviation, the manufacturer, has also developed the SS-11 and SS-12, improved antitank missiles which are suitable for mounting on helicopters or jeeps. NATO tests with the Nord missiles have been astonishingly effective.

Antitank missile development embraces a measure of irony. The British first used the tank in 1916, and General Charles de Gaulle in 1939 campaigned in vain for a mobile force of tanks in preference to placing reliance in the Maginot Line. In 1960 he is presiding over the demise of the very weapon which brought him initial fame.

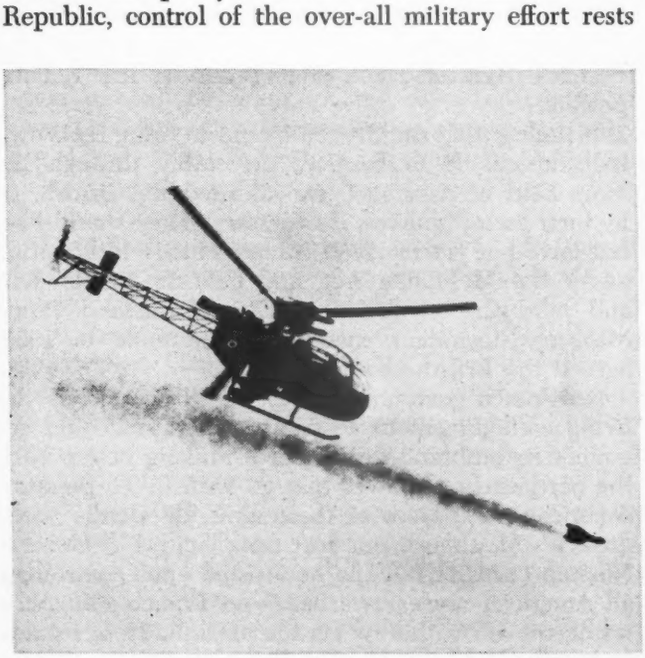
The rest of the French missile picture is not so bright. The French military establishment is encrusted with ministerial apathy, important technical limitations, some residual strains resulting from budget stringencies which in 1958 caused the protest resignations of Ingenieur General Louis Meyer and the Air Force Chief of Staff, General Paul Bailly, and, perhaps most important, an as yet unresolved interservice feud over roles and missions.

Under the policy direction of the President of the Republic, control of the over-all military effort rests with Pierre Messmer, the Minister of Armed Forces. Under him are three: The Ministerial Delegate for Air exercises authority through the aforementioned DTIA. The Ministerial Delegate for Army manages the DEFA (*Direction des Etudes et Fabrications d'Armament*), while the Ministerial Delegate for Navy presides over the fortunes of DCCAN (*Direction Centrale des Constructions et Armes Navales*).

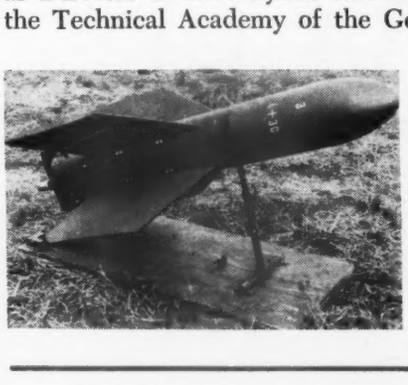
An interesting, almost startling, parallel may be drawn between the French and US missile organizations. DEFA delegates most research and production to the French Army's arsenals at Vernon and St. Louis, just as the principal US Army missile research role has been performed at the Army Ballistic Missile Agency at Huntsville, Ala., with subsidiary research and development carried on at a string of satellite Army arsenals. The Veronique, an excellent high-altitude sounding rocket, the Monica, a good upper-air test vehicle, the Parca, a surface-to-air missile that utilizes a beam rider and radar homing, and Entac, an ineffectual antitank missile, are all manufactured at the DEFA arsenal at Puteaux.

The DTIA, much like the US Air Force, has preferred to contract its research and production among airframe and power plant companies. Sud Aviation *(Société Nationale de Constructiones Aeronautiques de Sud)* is the largest aircraft company in continental Europe. Nord Aviation *(Société Nationale de Constructiones Aeronautique du Nord)*, producer of the SS-10, is also the largest missile manufacturer in France.

The French parallel with the US even extends to the staffing of key DEFA (Army) installations with German scientists. Dr. Hubert Schardin, now recognized as one of the world's leading ballisticians, served as Director of the Physics and Ballistics Institute at the Technical Academy of the German Air Force at



Above, a French Alouette helicopter lets loose one of the versatile SS-11 wire-guided missiles, one of the best antitank missiles in the world. This weapon and the slightly smaller SS-10 (at right) were developed by Nord Aviation.



Close-up of Nord's SS-11 antitank missile, which can be fired from jeeps or helicopters. SS-11 and -10 (below) may be produced under license in the United States by General Electric.

Nord Aviation's SS-10, a simple yet extremely effective wire-guided antitank weapon, is the first foreign designed and made weapon system to be bought in quantity by the US in years. Nord also makes the SS-11.

Berlin-Gatow from 1935 until the end of World War II. He was recruited for the job of Director of Ballistics at the French Army research center in St. Louis, Alsace.

This proffered employment took some pride-swallowing. The French overcame their traditional, some said instinctive, animosity for Germans. In the decade following the second World War, German scientists and technicians by the hundreds found employment in France, most of them in DEFA (Army) facilities.

German scientists are now liberally represented at the Army's LRBA (*Laboratoire des Récherchés Balistiques et Aerodynamiques)* which has produced some powerful thrust engines, including the one used to propel the successful Veronique. The Army also supervises the SEPR *(Société d'Etudes de la Propulsion par Reaction)* specializing in liquid-propellant research, and it controls *Service des Poudres,* cynically referred to as the "Powders Department," which has a monopoly to develop and fabricate all types of solid propellants. This type of control has somewhat inhibited the progress of the French chemical industry in relation to its own potential and to its British and American counterparts.

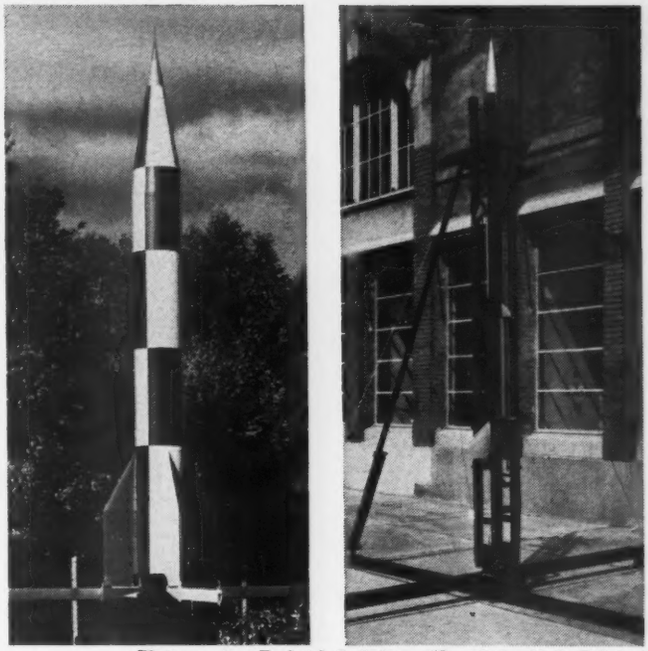
The table of organization of French missiles control —not readily depicted on one chart—makes the US military organization look like a positive model of efficiency. Even if President de Gaulle makes all the right political decisions, he will still have to scrape off the barnacles of organization grown onto the Ministry of National Defense over the years.

Among the unresolved disputes over service roles and missions, the DEFA (Army) bears the responsibility for surface-to-surface missiles. Incongruously, the Air Force presides over the short-range SS-10 and follow-up antitank missiles produced by Nord Aviation, presumably because this nationalized company has long been associated with the Air Ministry.

The Army's own antitank missile, the Entac, produced at Puteaux Arsenal, has proved to be wholly unsatisfactory. Reassignment of the SS-10 and follow-on missiles to Army jurisdiction has not been made. Instead, Puteaux has been forced to try, unsuccessfully, to adapt the SS-10 shaped warhead to the Entac body.

To further complicate the DTIA-DEFA tangle, the Air Force and Army have debated, then compromised their positions as to which one should control four battalions of Nikes that were made available in 1959 by the United States. First, it was agreed that the Army should man three battalions, and the Air Force the other. This arrangement was modified, although the ratio was not changed. In July 1960, the French sited the first operational Nike battalion in West Germany. The battalion was staffed with 800 men, of whom 600 were supplied by the Army; the remainder by the Air Force. In apparent exchange for this concession, the Air Force has been promised 100 percent control of the next battalion to be sent to the US for Nike training, scheduled for 1960.

The DCCAN (Navy) has been overshadowed by the other services and has been given no clearly defined areas of missile jurisdiction. The Navy has relied on the Army and Air Force for missiles that could be adapted for shipborne use. In the AAM field, the Navy has picked the bones of the German World War II



Photos courtesy Frederick I. Ordway, III, and Ronald C. Wakeford

The French rocket research program includes these two vehicles—at left, the Veronique, a single-stage, liquid-propellant vehicle whose latest version is designed to reach about 125 miles. At right, the Monica, a solid-propellant research vehicle which is launched from a small ramp with the aid of a pair of solid-propellant boosters.

Schmetterling, which was never brought to combat readiness, but was an advanced design for a rocket-powered, radio-controlled, subsonic missile intended to intercept massed Allied bomber formations.

The French Navy blames the Algerian pacification for draining its funds. Successive budget cutbacks have delayed completion of the *Foch* and *Clemenceau,* two advanced aircraft carriers.

At this juncture, the French could use US assistance, less financial than technical, to move up the ladder of accomplishment. Lockheed and Boeing have been approached for licensing privileges involving the Polaris and Minuteman, respectively. Such arrangements would necessitate US capital investment and a share in management. The French would dearly love to skip the liquid-propellant generation of ballistic missiles. In one jump, they feel they could approach the present technical level in the United States which we achieved after six years of intensive, expensive development.

There is a precedent for such arrangments. The French are participating in the production of the US Army-developed Hawk, designed to cope with low-level Soviet bombers. The *Société Europiénne de Téléguidage,* a consortium formed by French, German, Dutch, Italian, and Belgian firms, has been organized to produce Hawk. Each firm will supply selected components. Final assembly will be accomplished in France. SETEL is acceptable to de Gaulle, who wants European collaboration at the top under Joint American, British, and French leadership rather than the NATO-type integration at the base.

SETEL also restores some of the traditional continental balance of power. The French have resented bilateral agreements under which the US has furnished technical and financial assistance to the British nuclear energy and ballistic missile programs.

(Continued on page 53)

Put a Doppler here? Raytheon did!

Located in the tail section of the Convair B-58 Hustler, Raytheon's Doppler radar is subject to all the following: transonic and supersonic shock waves, intense tail-pipe and skin friction heat, turbulence from the pod, extreme vibration and acoustic noise levels, and very high altitudes.

Despite this environment, Raytheon's Doppler radar meets SAC's stringent accuracy requirements. It is boresighted on the ground, eliminating in-flight calibration, and is a prime sensor to Sperry Gyroscope Company's Bomb-Navigation System.

This Doppler is designated AN/APN-113. It was designed, developed and produced by Raytheon to operate reliably under the severest environmental conditions encountered by any aircraft today. It is a dramatic demonstration of Raytheon's capability to overcome environmental barriers.

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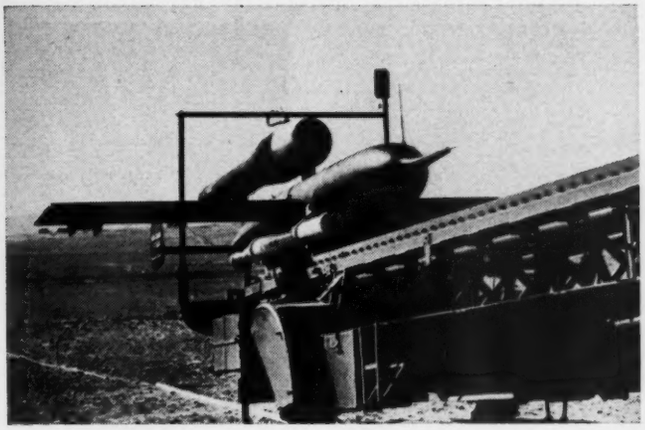
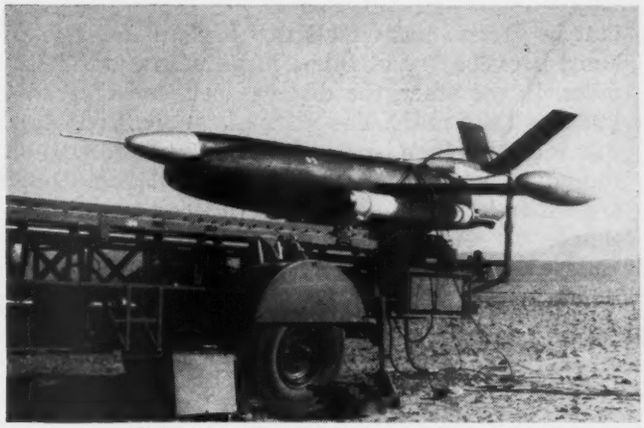


The Nord Aviation CT-10, above, is a remotely controlled, pulsejet-powered pilotless target aircraft that is used by the French for antiaircraft and antimissile gunnery training.



Photos courtesy Frederick I. Ordway, III, and Ronald C. Wakeford

Another French pilotless target is the Nord CT-20, which is powered by a turbojet and controlled by radio. It is launched with rocket assist with a short, mobile ramp.

Balance of power implications aside, there is a prestige burr under the saddle of French willingness to pull its share of the NATO load. It sticks President de Gaulle every time someone in Washington says the French cannot be trusted to keep nuclear and missile secrets from the Russians.

Another program, long range in effect, and one which should be carefully observed in America, is restoring the continental balance of power. The French and Germans, traditional rivals, have attained understanding to a degree and at levels not believed possible ten years ago. As we learned after the fact, some 600 Germans, headed by Professor Schardin, had moved over to France after World War II. Schardin has become a moving force in the joint effort to pool French and German financial, technical, and personnel resources on the basis of complete equality.

In May 1953, a secret meeting was held at the LRT *(Laboratoire de Récherché Technique)* which does significant basic research. Scientists of both countries have pledged their cooperation to develop a missile program. In the past three years, the cooperation has become bolder. In 1958, Professor Etienne Vassy, head of the Department of Atmospheric Physics at the Sorbonne, lent his considerable prestige to the program. He is now working closely with German physicists at the *Max Planck Institut für Physik*, one of the world's leading institutions outside the Iron Curtain for basic research in physics.

As a result of these and related efforts, the Franco-German Research Institute was born on March 31, 1958, at St. Louis, Alsace, through agreement signed on a Defense Ministry level. France would benefit through any operational missiles deriving from the joint efforts; Germany would benefit from up-to-date scientific information about weapons development which by NATO restrictions she is now forbidden to research or produce.

As the German *rapprochement* has emerged from behind closed doors, Frenchmen with long memories have greeted the German *rapprochement* with less than wild enthusiasm. However, they may be expected to swallow their fears as a result of the rocket-rattling performance of Mr. Khrushchev.

President de Gaulle himself has sought to counter his countrymen's reserve with public statements, such as the one in December 1959 that cooperation with Germany is "the condition and perhaps the grandeur and glory of tomorrow's civilization." He never before committed himself so categorically to Franco-German partnership, even though he now reminds audiences that in 1945 he proclaimed that the Rhine must cease to be a "ditch," and become a "link" between the two nations.

In the short run, any estimate of French missile development must be tempered by distinctions between actual progress and press reports of same. In May 1959, for example, the French let it be known that they had developed a surveillance radar capable of detecting "a man at ten miles and a horse at fifteen miles." In September 1959, a science writer for *France Soir* reported "reliably" that France could send a single-stage rocket to an altitude of over 400 miles, and that a French satellite would soon be placed in orbit.

We must consider that such announcements may bolster the prestige of the de Gaulle government. The successful atomic blasts of February and April certainly gave impetus to internal hopes that France nears parity with the other great powers, hence stands ready to exchange military information with them on a basis of complete equality.

Charles de Gaulle would wish for nothing better than for his national guided missile program to succeed without important outside help, as did his atomic project. But this objective is complicated by the dichotomy of French interests in North Africa. The French would dearly love to terminate the costly war and grant self-determination leading to Algerian "independence," but this concession does not presently include abandoning either the atomic testing grounds near Reggane, the guided missiles test range at Colomb-Béchar, and not least, the rich oil deposits recently discovered in the Sahara.

The usefulness of Reggane in a world increasingly sensitive to the hazards of nuclear fallout is obvious. The Colomb-Béchar missile test range is also impor-

(Continued on following page)

tant in French plans for space exploration. The distance between it and Bilma in one direction is 1,250 miles. In the other, the distance between Biskra and Podor is 1,875 miles. The Sahara is a "civilized" desert that is crossed by a large number of trails. It combines the advantages of terra firma with isolation. Deserts are easier to equip and utilize than oceans. It is far simpler to find a space capsule in the sands than amidst the Atlantic or Pacific waves. These considerations impelled the French to set up and equip the expensive missile test center which is now officially known as the *Centre Inter-Armées d'Essais d'Engins Speciaux.*

As the "Loi-Programme" brings new missiles out of research and development to test stage, CIEES will play a growing role. Just how much will depend on the outcome of several interconnected contingencies. In the tenuous negotiations for Algerian "independence," the rebels may insist upon relinquishment of French

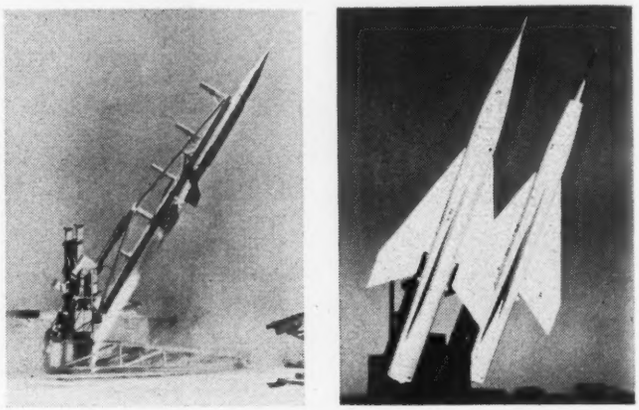
Photos courtesy Frederick I. Ordway, III, and Ronald C. Wakeford

The zero-length-launched SE-4200, a unique tailless ramjet-powered bombardment missile under development since 1950 by Sud Aviation, is in service with the French Army.

rights to Colomb-Béchar. This would be unacceptable to de Gaulle unless he could obtain generous test privileges at Cape Canaveral or Woomera. The Americans and British, respectively, are not likely to yield such concessions unless the French cooperate with NATO to a degree that de Gaulle is presently not willing to accept. Thus, it would appear that future progress of the "Loi Programme" depends as much upon complex political arrangements as upon French technology.

In outlook, the French have accomplished much in guided missiles with relatively limited resources. Like the British, France under de Gaulle has nurtured the dream of an independent nuclear deterrent. But the considerations that have driven the British to abandon this goal apply with equal or greater force to the French who are behind in nuclear and missile know-how and no better equipped to pay the bill.

Yet France is determined, for nationalistic as well as strategic reasons, to possess a ballistic missile, for it is now in the embarrassing position of having an atomic bomb, as crude as it may be, with no way to deliver it any respectable distance. The 1960 budget would remedy this by providing $81 million to produce about fifty of the new Dassault Mirage IV bombers.



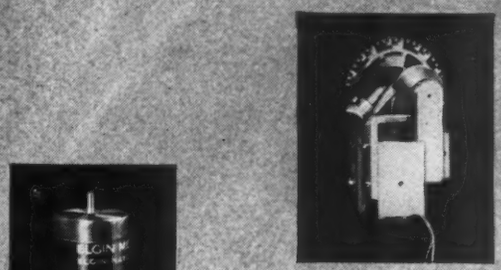
The Maruca, left, was developed by DEFA for the French Navy as a test vehicle for components of the Masurca ship-to-air weapon. Nord's ACAM, right, is a surface-to-air weapon, similar to US Army's Hawk. Photos from *International Missile and Spacecraft Guide*, by Frederick I. Ordway, III, and Ronald C. Wakeford, McGraw-Hill, 1960.

But these planes won't roll off the assembly lines before 1963, even if money tentatively promised in 1960 is released. Meanwhile, de Gaulle will strive for technical assistance by cooperation with Germany and the US in developing a solid-propellant ballistic missile. In this eventuality, he would need no bombers.

The shattering of the Summit Conference in May by Premier Khrushchev and the blustering, truculent attitude he assumed toward the United States portends the onset of a period of chilled relations between East and West. One by-product of the renewed cold war has been a reexamination of Franco-NATO relations and especially Franco-US differences over technical and financial assistance to French nuclear and missile development programs. Several months ago, Defense Secretary Thomas S. Gates, Jr., proposed a formula to the NATO Defense Ministers which would place missiles such as Polaris in the hands of NATO forces.

In July, Secretary-General Paul-Henri Spaak advanced a NATO plan which in effect asked de Gaulle whether, in exchange for Polaris and other late-type missiles, he would be willing to accept and man with French soldiers other missiles that would remain under NATO control. This proposal has not yet received American approval, but it is unlikely that Spaak would advance it without serious belief that it would be acceptable to Washington—if the French leader could be persuaded to go along. If some such understanding can be brought about, President de Gaulle will have vaulted the Fifth Republic into truly ranking status without costly trial and error.—END

The author, Murray Green, is a civilian aide at Headquarters USAF. He holds B.S. and M.S. degrees from the City College of New York and a Ph.D. from American University, Washington, D. C., in history and international relations. Mr. Green is a reserve major in Air Force intelligence. He served as a naval officer in the Pacific in World War II.



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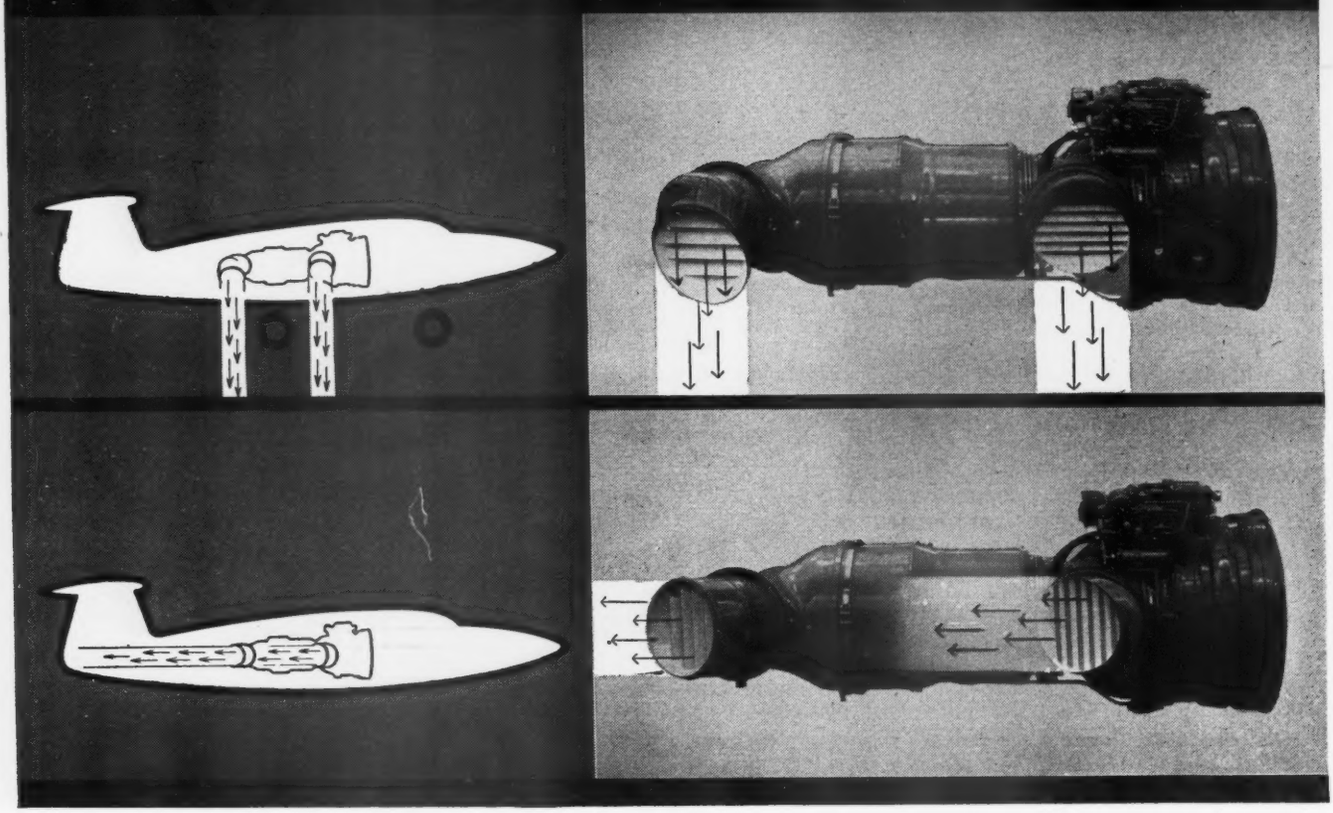

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HOBGOBLINS FOR THE GULLIBLE

Prussianism and the Man on a White Horse

W. Barton Leach

THE NECESSITY for true unification of the armed forces becomes more and more apparent with the passage of time.

So, too, its opponents become more and more firmly committed to arguments based on pseudo-history and fiction. Let us look at them in the clear light of fact.

Generally, to answer calls for establishment of a streamlined, space-age military organization, the opposion conjures up two familiar figures:

- The Prussian General Staff officer played by Erich von Stroheim with monocle and *pickelhaube.*
- The Man on a White Horse played by a figure who, depending on the susceptibilities of the audience, resembles Premier Tojo, Count von Moltke, Juan Peron, Oliver Cromwell, or the Union Major Generals of the Reconstruction period.[1]

These two characters appear briefly on the stage, are insulted, spat upon and flayed, and retire to the wings. No one defends them—and no one wants to—though occasionally someone mentions that they have no more to do with the subject under discussion than Simon Legree in a production of "My Fair Lady."

The antiunification argument, or implication, is this: If we create an Armed Forces General Staff with a single chief of staff, this will be the equivalent of the Prussian General Staff, will create a military authority which will dominate the government, and will turn the United States into a militaristic equivalent of the Kaiser's Germany or Tojo's Japan. A variant of this argument deals with the *Oberkommando der Wehrmacht* (OKW) of Hitler's day, of which more later.

Defense organization is a serious business. Bad organization can produce tragic results, as any student

(Continued on following page)

1. *The discrimination against white horses stems from the book of Revelations, vi, 2: "And I saw, and behold a white horse: and he that sat on him had a bow; and a crown was given unto him: and he went forth conquering, and to conquer." Doubtless Mussolini had this apocalyptic symbolism in mind when, as Rommel drove into Egypt in 1942, he actually ordered a white horse for the expected triumphal entry into Alexandria. But aren't we Americans entitled to our own symbolism from our own history? Let us remember that Traveller, the charger of Robert E. Lee, was white or nearly so, that Washington himself, the Father of His Country, was similarly mounted, and that the only white horses today are props for the equestrienne in the circus. None of these individuals has proved particularly dangerous to our liberties.*

of military history is aware. Sound organization can make the most of men, money, and materiel. The subject ought not to be cluttered up with historically inaccurate, emotionally charged irrelevancies. This article seeks to avoid this in the future. After quotation of typical recent versions of the General Staff/White Horse thesis, three points will be made:

> The Prussian General Staff was an *Army* staff, not an interservice staff; and the United States has had this type of staff organization in each of its services throughout this century.
>
> No major power has ever had a true interservice general staff with a single chief of staff. If we develop one it will be our own made-in-America model dictated not by foreign patterns but by the logic of current affairs.
>
> America's safety from military despotism stems, not from any form of military organization, but from the American ethos, shared alike by those in and out of uniform, and from the political sophistication of a literate people with a long tradition of freedom.

Variations on a Theme

The Prussianism/Man-on-Horseback thesis is presented by what may be called the A-A-A Method: Assumption, Assertion, and Association. You assume that the General Staff organization was responsible for all the crimes of militarism in whatever country; you assert that any proposal for further unification will produce an equivalent of the Prussian General Staff; and then you associate the proposal with some prophecy hateful to the audience addressed.

The presentation may be very short or quite long. Here is a short one as it appeared in a 1958 circular to a service group:

> **"PENTAGON PLAN ESTABLISHES SUPREME PRUSSION [SIC] TYPE HIGH COMMAND. WILL MEAN END OF NAVAL AVIATION AND MARINE CORPS."**[2]

As well as being short this format is easy; you don't even have to know how to spell Prussian. But it probably is not compelling except to the faithful who are adjusted to receiving The Word without excessive reflection or analysis.

A medium-length version, taken from a debate in the House, illustrates the technique of confusing the German General *Staff* as a form of *headquarters organization* with the German General *Staff Corps* as a self-perpetuating *military elite:*

> "If you would read these hearings, you would think that the Prussian staff system was the most benign thing in the world. Maybe they think no one on the committee reads any history.... From the time of Scharnhorst until von Moltke's retirement there was a period of about seventy-five years. That is how long it took to build up the power and prestige of the Prussian general staff.... The chief of staff of the German Army was so powerful, because of the power that had been built up in that office, that the Iron Chancellor of Germany fell when the chief of staff of the German Army decided it was time for him to fall.... [The 1958 Reorganization Bill as drafted in the House Armed Services Committee] does not permit to happen what has happened in many other places."[3]

Of course no one in this country has ever proposed imitation of the military elite known as the General Staff Corps headed by a chief with indefinite tenure (thirty years in the case of von Moltke).

Quite the contrary: We have a built-in discontinuity of leadership through the policy of appointing service chiefs for two-year terms, the provision of the 1958 Reorganization Act that members of the Joint Staff may serve for only three years and then must serve three years elsewhere before returning, and the old Manchu Law limiting all Pentagon officers to four-year terms. The question raised by these rules is not whether we risk military domination but whether any large complex operation of either business or government can work with such a rate of turnover.

Most lengthy and elaborate is the historical roundup presentation. This is really the easiest to combat, because once the antiunificationist gets into the realm of fact and history instead of assumption and innuendo it becomes possible to show that his facts are fiction and his history imaginary. Here is an example from a debate in the Senate:

> "The basic ingredients of the Prussian system are a top-level or 'joint' staff and one military person who directs the staff and is the sole or principal adviser to the nominal civilian superiors.... The details of format have little significance. All that is necessary is to abandon or bypass our Joint Chiefs of Staff system by setting up one man assisted by an over-all staff and we will have a supreme general staff, after the pattern of Scharnhorst, von Moltke, Ludendorff, and the militaristic lackeys of Hitler....
>
> "Wherever freedom has died, wherever conquest and oppression have been rampant, there will be found a variation of the Prussian-type supreme general staff. It directed the malignant militarism of Germany under both the Kaiser and Hitler. It was the organizational device by which Tojo and his militaristic clique ruled Japan and brought on the disaster that engulfed her. It provided the basic military pattern supporting Mussolini's Fascist dictatorship. It is the system in substance adopted by the Kremlin for making military power the tool of Red dictatorship within Russia and the evil militaristic brain for directing the world conquest of communism."[4]

Let us now take, one by one, the items in this impressive catalog of militaristic crime:

The Kaiser's Germany: The General Staff Corps, headed by Scharnhorst and his successors, played a dominant role in Germany's aggressive militarism and hence in bringing on World War I. But it was the elite Corps (in German, *Generalstab*) not the headquarters staff (in German, *Generalstab des Heeres*) that was the culprit. Is this a semantic quibble?

The fact is, similarity of names in both German and English creates a semantic hazard worthy of a few sentences of explanation.

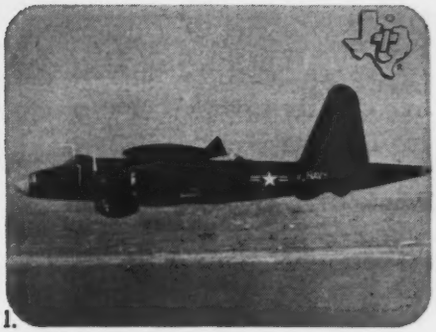
(Continued on page 61)

2. Acona News, *April 8, 1958, signed by Adm. J. W. Reeves, Jr., National Chairman of Acona (Advisory Council on Naval Affairs of the Navy League).*

3. *Speech by Representative Paul Kilday of Texas, June 5, 1958, at page 9211 of the* Congressional Record.

4. *Speech by Sen. Styles Bridges of New Hampshire on the floor of the Senate, July 23, 1956. (On the same day Sen. Hubert Humphrey (Minn.), Paul Douglas (Ill.), and Leverett Saltonstall (Mass.), did me-too's to Bridges's speech.)*

TI IN MILITARY ELECTRONIC SYSTEMS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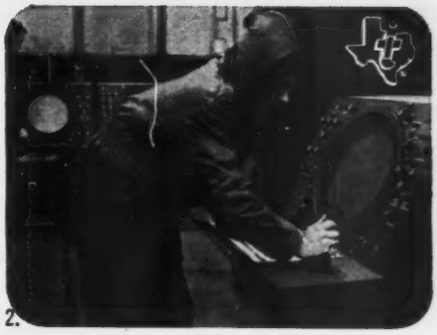
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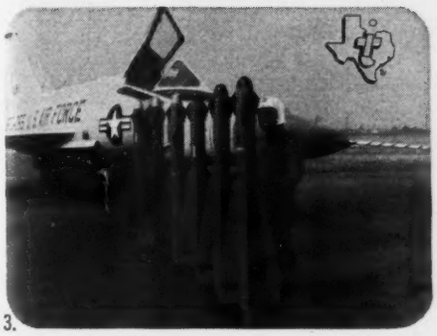
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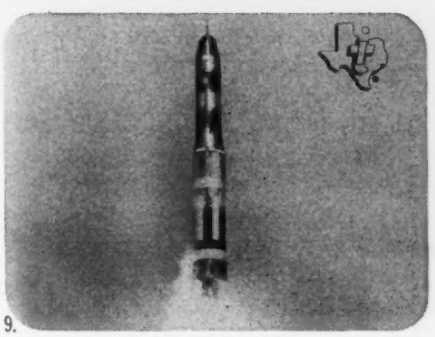
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2. TARmac ASR-4 Airport Surveillance Radar for the Federal Aviation Agency.

3. Infrared optics for the U.S.A.F. FALCON Air-to-Air Missile, built by Hughes.

4. Anti-personnel Mine Detector AN/PRS-3 (XR-12) for the Corps of Engineers.

5. AN/APS-38A surface search radar, AN/ASQ-8 magnetic anomaly detector for the U. S. Navy S2F-1 ASW aircraft, built by Grumman.

6. Telemetry and guidance subsystems for the U. S. Navy CORVUS Air-to-Surface Missile, designed and produced by Temco.

7. AN/AQS-4 and AN/AQS-5 dipping sonar for the U. S. Navy HSS-1N ASW helicopter, built by Sikorsky.

8. AN/APS-80 surface search radar, AN/APA-125A radar indicator, AN/ASQ-8 magnetic anomaly detector and TD-239A intervalometer for the U. S. Navy P5M-2 ASW patrol seaplane, produced by Martin.

9. Programmers for the U.S.A.F. TITAN Intercontinental Ballistic Missile, built by Martin.

10. Surveillance sensors for the U. S. Army Signal Corps SWALLOW AN/USD-4 Combat Reconnaissance Drone, produced by Republic Aviation.

11. Surveillance sensors for the U. S. Army Signal Corps AN/USD-5 Combat Reconnaissance Drone, produced by Fairchild.

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Marine helicopter test-fires Bullpup missile. As a Marine HUS-1 helicopter hovered at 1,500 feet, a jet of flame streaked from near its starboard side. The Bullpup missile flashed away—out to take a bite of its prey, a target floating in the Chesapeake. The 12½-foot, 570-pound Navy Martin Bullpup missile was the largest and first radio-controlled missile ever fired from a helicopter. Once launched, the pilot guides the missile to target by a switch on his control stick. The two together, Bullpup and helicopter, may turn out to be the perfect combination to provide close ground support for troops. It would implement battlefield firepower with effective punch.

Operation face lift. Thirty U.S. Army H-37's, largest helicopter flying in the free world, are being flown to Sikorsky's Connecticut plant for modification. Major face lifting items include equipment for automatic stabilization and for the standardization of communications. Other improvements will step up operating efficiency... extend the helicopter's range... and cut down operating and maintenance costs. The H-37, ordered from Sikorsky in 1954-55, set a world speed record of 162.7 miles an hour in 1956. Driving the five-bladed, 72-foot diameter main rotor are two 2,100-horsepower engines from Pratt & Whitney Aircraft.

Helicopters do the work of fire extinguishers. A forest fire was raging in Carbon Canyon, south of Los Angeles. Seven Marine HUS crews of HMR 361, carrying special fire fighting kits, bombed with chemicals and water the woodlands ahead of the fires. The blaze was stopped from spreading. Next, the fire itself was drenched and then finally extinguished with the same solution. Runs on the target were made at altitudes of 40 to 100 feet at speeds of 40 to 60 knots.

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The Corps was a specially selected, trained, and indoctrinated group of officers who, once attaining Corps status, retained it for life. From them field commanders and their staffs were chosen; but they continued to be Corps members even though they were in Africa or in a POW camp. Naturally, the headquarters staff was manned chiefly by General Staff Corps officers; but this was not necessary, for an officer could be on the staff without having attained Corps membership.

Still, for purposes of our present discussion, this whole matter has only marginal relevancy; for both the staff and the Corps were strictly Army organizations. There was no two-service headquarters staff that we in this country are considering.

Hitler's Germany: The phrase "militaristic lackeys of Hitler" is quite precise. Hitler dominated his generals, not the reverse. Hitler consistently took military risks that his generals opposed as too risky. There is not the slightest evidence that the General Staff—or any other military authority—dominated the civilian authority which, whether we like it or not, was Adolf Hitler.

Tojo's Japan: Japan had no interservice general staff, nor even a Minister of Defense. The Army and Navy bickered outrageously. Japan's militarism stemmed from the warrior samurai tradition and the code of bushido, plus the constitutional requirement that the War and Navy ministers be service officers on the active list—which put any government at the mercy of the military services. Once again, militarism was produced by an elite corps and military tradition, not any type of staff organization.

Mussolini's Italy: This was a party dictatorship, ruled by Mussolini and his Blackshirts. No military figure was significant.

The Soviet Union: Also a party dictatorship deriving its oppressive power over the Russian masses from the secret police headed by such men as the unlamented Lavrenti Beria. The military power has never been dominant. If anyone thinks the contrary let him consider what has happened to Marshal Zhukov, the greatest Soviet war hero, and Marshal Bulganin, the "B" of "B & K."

And let us add two more items occasionally mentioned:

Latin America: Military dictatorships are endemic. But the Perons, Trujillos, and Batistas have not relied upon interservice staffs, for there are none. These countries have had Army dictatorships, frequently led by a colonel (Peron) or a sergeant (Batista), not by a general at all.

France: In 1958 the French Army in Algeria precipitated a crisis that brought de Gaulle to power; and in 1960 Army elements cooperated affirmatively or negatively with the white settlers who briefly revolted against de Gaulle's Algerian policies. But this was an Army affair, not an interservice operation. It had no relation to any type of headquarters staff organization; indeed it was a revolt by troops in the field in defiance of orders from Army headquarters.

Thus, when we examine these examples of militaristic domination one by one, we discover that the charge that they derive from a national chief of staff heading a three-service staff proves to be based on garbled facts and spurious history thickly coated with emotional phrases. Those who present these views doubtless have no intent to mislead, but rather have themselves been misled by the constant repetition and uncritical acceptance of these statements over a long period of years.

The OKW Myth

A related expedient of the antiunificationists is to declare that Germany tried a national general staff in World War II—and doesn't everybody know Germany lost the war? The top staff, it is said, was the *Oberkommando der Wehrmacht* (OKW), which as a name offers the debating advantage of a repulsively gutteral sound. A War Department Technical Manual (TM-E-30-451) is offered to prove this, complete with a US-type organization chart showing Hitler in a box at the top, Generalfeldmarschall Wilhelm Keitel directly under him as "Chief of Armed Forces High Command (Chief OKW)," and no fewer than thirty-eight staff sections under Keitel.

The manual starts with this assertion: "The basic principle under the German military system is unity of command.... Under this system the Army, Navy, and Air Force are regarded as branches of a single service (*Die Wehrmacht*), headed by the Armed Forces High Command (*Oberkommando der Wehrmacht* or OKW). The OKW controls all matters of interservice policy in both peace and war. It is responsible for all preparations for national defense in time of peace, and for the conduct of operations in time of war."

Well, you are expected to say, how can anyone doubt *that*? And if it didn't work for the Germans, why should we buy it? So let's dig a little deeper. The manual bears the date March 15, 1945. At that date our sources as to what German staff organizations were *called* were good, but our knowledge of how they *worked* was sketchy.

Since the end of World War II our historians have had access to the German archives. Our prosecutors turned the German military system inside out at the Nuremberg trials. We now know that the OKW was not an interservice staff at all but was a small personal Army Staff for Hitler composed of officers loyal to the Nazi Party. It was charged with keeping under control the Army General Staff (OKH) which, to say the least, had its reservations about Hitler. Goerlitz's *History of the German General Staff* and Telford Taylor's *Sword and Swastika* are conclusive on this point. While exact figures are hard to come by, it appears that the total personnel of OKW never exceeded fifty or sixty. Photographs of the leaders show a group of Army officers with one Navy and one Air Force officer of junior rank, apparently serving in a liaison capacity.

The testing ground of OKW, if it was really trying to be a national general staff, was Operation Sea Lion—the proposed invasion of England after the conquest

(Continued on following page)

of France. Do we find OKW preparing a master plan and dominating this triphibious operation? Not at all. The Navy under Admiral Raeder prepared one plan; the Army under General Halder prepared a completely different plan; and Goering sent his Air Force off to the Battle of Britain to defeat the RAF, but then, when his enemy was almost knocked out, shifted his attack to London without regard for the effect of this on the total operation. Nobody at OKW would have dared to tell Reichsmarschall Goering what to do.

When the Allies undertook to cross the Channel in Operation Overlord, we appointed a Supreme Commander and placed the forces of all three services under his command. In Sea Lion the Germans did not even have a theater supreme commander, to say nothing of a true chief of the armed services at headquarters. Here is what Churchill has to say of this episode:

> "It is apparent from the records that the German High Command were very far from being a coordinated team working together with a common purpose and with a proper understanding of each other's capabilities and limitations. Each wished to be the brightest star in the firmament. Friction was apparent from the outset, and so long as [Army] Colonel-General Halder could thrust responsibility on to Admiral Raeder he did little to bring his own plans into line with practical possibilities. Intervention by the Fuehrer was necessary, but seems to have done little to improve the relations between the services. In Germany the prestige of the Army was paramount and the military leaders regarded their naval colleagues with some condescension."

Note that planning was done separately by the Army and Navy, not by OKW, and that Hitler personally—not OKW—had to step in to render a decision.

Why all this analysis of OKW? Because many people have the idea that US proposals for a national chief of staff and general staff are foreign imports from a discredited military system. This is not true. If we adopt these proposals they will be all-American products based upon a study of the mistakes we and others have made and upon a reaction to the logic of events.

A Militaristic America?

"Never" is a long time—so one would hesitate to say that the United States would never succumb to militarism or communism or any other ism. But anyone capable of reading the record can confidently predict that militarism will be neither created nor prevented, neither accelerated nor retarded, by any particular form of headquarters staff organization.

Militarism is a virus with as many strains as influenza.

It can be a sociological phenomenon as in the Kaiser's Germany—saber-scarred youths with high connections in politics and finance choosing the Army as a career, goose-stepping their troops, and toasting *Der Tag*.

It can be an economic phenomenon with overtones of religion and racist pride as in Tojo's Japan—an overpopulated island feeling itself strangled while brimming with contempt for its weaker neighbors whose natural resources it covets.

It can be a reaction intentionally induced by a civilian dictator as an instrument of foreign policy as in Hitler's Germany—shouting masses of brownshirts, marching phalanxes of storm troopers, and a frozen-faced Fuehrer staring down the leaders of Britain and France at Munich.

It can be the outgrowth of political immaturity, illiteracy, and soul-destroying poverty as in some of the Latin American countries—masses of men and women who have never known human dignity, who have never had the right to vote and never missed it, and who long for a father-image in a striking uniform who will promise them peas and rice and coconut oil.

But there is not the slightest evidence that militarism follows from any form of staff organization. There is no correlation at all. The proof is easy: In this country we have had a Prussian-type general headquarters staff in the Army since 1904 and in the Navy since a few years later. The 1904 reform was pushed through by Secretary of War Elihu Root because of gross staff failure during the Spanish-American War; and, as you would expect, it was opposed by vested interests within the Army on the ground that it would lead to military dictatorship. Yet here we still are a half-century later.

Suppose one were plotting to establish a governmental structure most congenial to a military dictatorship, with or without the White Horse, how would he build it? Here is one solution: Create a strong chief executive, make him commander in chief of the armed forces so that every officer and man reports to him, and then get the habit of electing victorious generals to that high office. No better formula could be devised—and, of course, it is a formula for American government established with the Constitution and the Washington Administration.

No, the security of this country from military dominance rests on no such flimsy foundation as a particular form of staff organization. It rests upon the political sophistication of the American people, their abhorrence of any form of dictatorship—civilian or military—and the ethos they have developed over a period of nearly two centuries. The danger in our time is not that our military leaders will become too strong in the councils of government but that we shall keep them too weak.—END

The author, W. Barton Leach, is a professor of law at Harvard University, where he has been instrumental in establishment of the Harvard Defense Studies Program. He served as an Army enlisted man in the first World War, as an Air Corps officer in the Second World War. At present he is a brigadier general in the Air Force Reserve. Professor Leach has been a consultant to the Secretary of the Air Force since 1947. He has been a frequent contributor to this magazine in past years. He is also the author of several law books.

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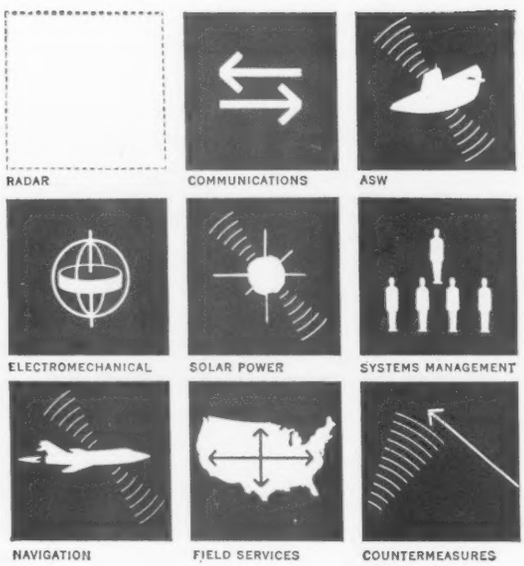

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THE SPACE AGE IN PERSPECTIVE

SPACE DIGEST

VOLUME 3, NUMBER 10 • OCTOBER 1960

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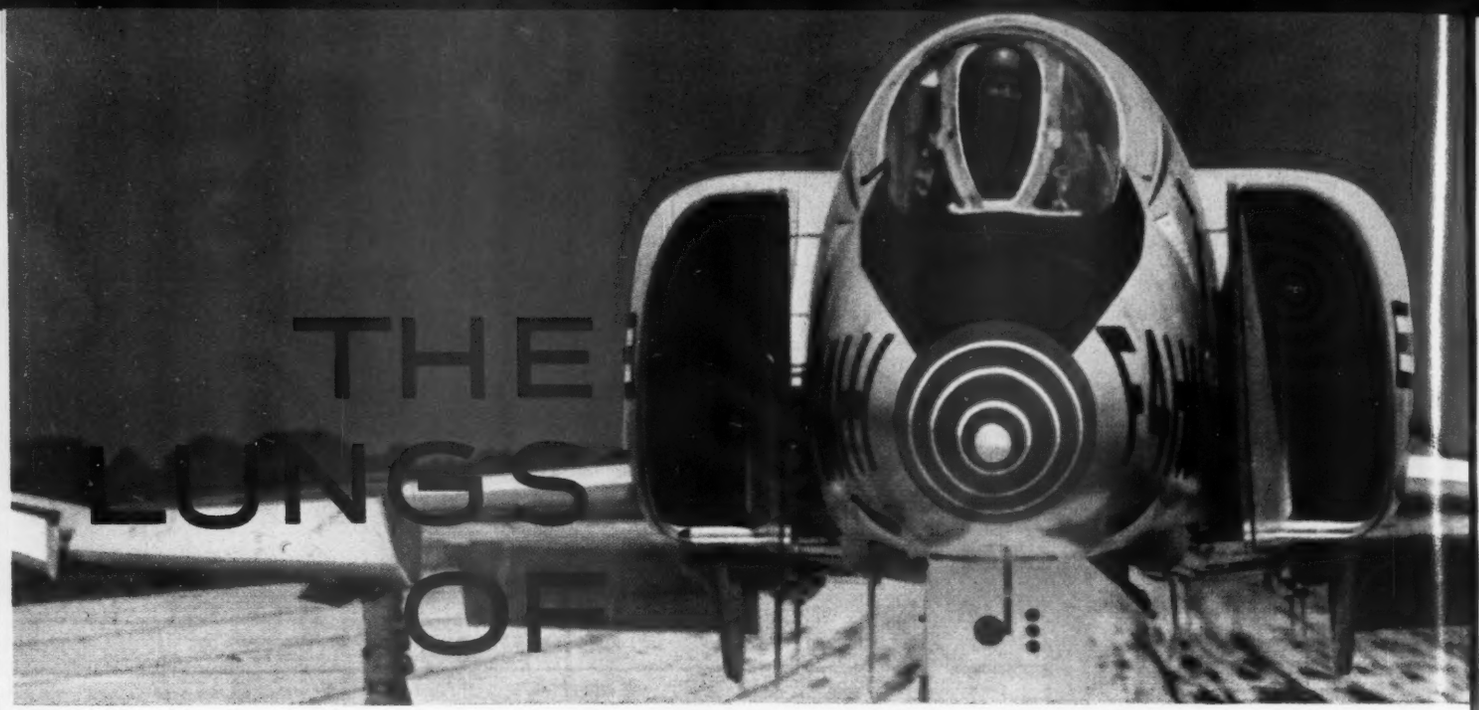

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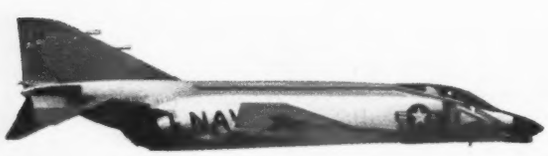

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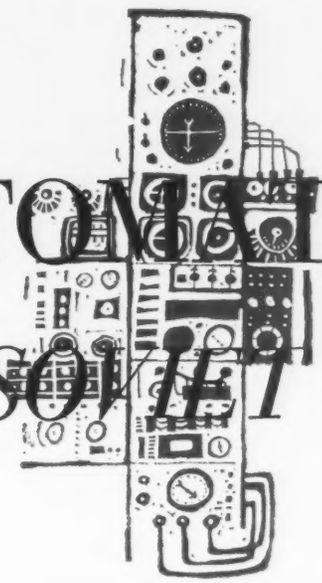
Man is headed for an automated future, no matter what tomorrow's world political organization is like. And science in the USSR is already contemplating the impact of automation on communist society. Here are some notes on . . .

AUTOMATION . . . A SOVIET VIEW



V. A. TRAVEZNIKOV

WHAT can automation give humanity?

First, automation spells a steep rise in labor productivity. Of course, automation is by no means the only factor contributing to scientific and technological progress which results in higher labor productivity and expanded production of the good things of life. A big role here will be played by advances in controlled fusion, synthesis of man-made organic substances including foods, and in the multitude of other sciences and branches of technology. However, all departments of knowledge today are knitted together closer than ever before, and their further headway is inconceivable without automation. To cite but a few examples, man owes to automation his space prowess, photographs of the moon's reverse side, and the very existence of powerful means of research like the proton synchrotron.

Automation will bring in its wake a big leap in productivity not only because man will not have to operate machines by hand, and a single operator will be able to attend to many automatic units at a time. What is more important is that the expansion of production will no longer be constrained by the human factor in process control.

In many cases today, the rate of industrial processes is restricted by the potentialities of control. Man's response to environmental changes is rather slow. This is why we can only use slow processes.

Automation will revolutionize the majority of manufacturing techniques, as it will provide for control of industrial processes which occur at extremely high rates and on a large scale. While our practice to date has been confined to stable processes, automatic control will place unstable processes at man's disposal as well. Man will be able to control both the outcome and kinematics of reactions.

Atomic energy is but one example of how an effective control system has enabled man to utilize extremely dangerous phenomena to the best advantage. With absolute confidence in automatic instrumentation, it will be possible to maintain processes as close as possible to critical operating conditions. As a result, use will be made of the processes which seem to be beyond man's control today.

The goals of automation can only be achieved when all steps of the industrial process have been

automated in all basic industries, transport, and building, including the assembly, adjustment, inspection, shipment, and distribution of the finished product; that is, when comprehensive automation has been realized to cover ramified remote-control systems widely using computers.

It stands to reason man cannot possibly be excluded from this process entirely. Supervision, maintenance, research, and development will always call for his more or less regular attendance. It is beyond any shadow of doubt that man's potentialities in the field of control are great indeed and will never, it appears, be fully surpassed by machines. Therefore, it is the foremost and noble task of scientists in the field of automatic control theory, physiology, psychology, and technology to find the best possible uses for man in control systems and to create the best possible conditions for man's activity in process control.

Not only will automation raise productivity, but it will also radically change the very nature of labor. Already now a number of arduous and hazardous occupations have almost completely been done away with, and the trend will continue. In many cases you can no longer see the stoker doing his exhausting job, while those of the steelmaker and blast-furnace operator have become appreciably easier to do. Looking farther out into the future, automation will completely take over jobs involving elevated temperatures and pressures, contaminated or harmful atmospheres. Automation will help turn manual labor more and more into mental work, thus removing the difference between them, so that man's energy and vital strength directly involved in production may be utilized to an ever greater degree not for process control or—less so—for manual labor, but to produce and realize novel engineering ideas, such as would further relieve man of direct participation in production and would give him abundant life and more leisure.

The higher labor productivity and expanded material production stimulated by automation will sharply improve the standards of living and reduce the working day to but a few hours in the near future.

The full utilization of the benefits arising out of automation, however, is only possible in a rationally organized society where the manpower made redundant due to automation in one field is easily absorbed in others. Our firm conviction—which we do not, of course, impose on anybody—is that this possibility is offered by the socialist system.

With increasingly more material benefits available due to automation, a smaller proportion of people will be needed in production. A larger number of them will be concerned with research and development, public health and the arts, making our communities better places to live in by laying out parks and gardens and so on.

With more leisure time, means, and possibilities at his disposal, man will be able—for the first time in history—to devote to himself the attention he rightly deserves. An era will set in of a scientific approach to human health, with emphasis on balanced daily regimen and diet, sports and prophylaxis. Medical and biological sciences will be given priority to the point where the main duty of the physician will be that of prophylaxis, and every case of disease will be regarded as an emergency. Automation's important contribution to medicine will be automatic and semiautomatic apparatus to watch the patient's health, keep his case history, diagnose and treat his ailments.

Automation opens up vast vistas before science. The spectacular breakthrough into space is the case in point. Indeed, progress in automation is a

Photo courtesy of IBM

One use of automation. Typist copies Pravda *text on machine which converts Russian letters to punched tape. Tape is "read" electronically and compared to dictionary stored on "memory" disc.*

decisive factor in manned space travel which, I believe, this generation will live to see. In turn, the breakthrough into space is bringing about rapid headway in our knowledge of many crucial problems which have been challenging men of science for centuries. The origin of life, extraterrestrial life, the fate of the earth as a planet—all these and other problems which have always been on the mind of man are approaching their solution thanks to space research and, hence, to automation.

Mention should also be made of biology—or more specifically—of control in living organisms. These problems closely relate to that of the origin of life. Automation will undoubtedly speed up their research. In turn, automatic control systems stand to benefit much by investigations into living beings.

Automation is changing the forms and techniques of research in many departments of science and technology. The very process of cognition is being speeded up. Our knowledge is growing in a kind of chain reaction. The more we learn, the wider the horizons and prospects in front of us, the ampler opportunities for further progress of research, discoveries, and knowledge. This, however, poses further difficulties. For one thing, it is becoming increasingly difficult to store the huge wealth of information and to transmit it in concise, condensed form.

On the other hand, it is becoming increasingly difficult to glean new data, to carry on new studies, as science is ramifying at a high pace. Whatever we look at—numerous experiments on alternative chemical reactions made to find unknown properties of chemical substances; studies into the living cell; investigations into conditioned reflexes; research into economic and other complex problems—all this takes a heavy toll of human effort, and of skilled effort, for that matter. In the future, human work will be substantially supplemented and partially supplanted by automatic machines. Automatic systems with a minimum a priori information put into them by the designer will collect information in new fields of knowledge. Already now the researcher is equipped with a variety of measuring, recording, and computing machines. In the future a veritable research industry will emerge, based on specialization, cooperation, and use of machines.

The automatic machines helping the investigator can be self-learning. They may learn simple skills for limited assignments. In fact, it is not impossible in principle to make them acquire a kind of "creative" skills, that is improve automatically their performance in complex fields. Today, no limits can be forecast for the development of such systems. It is not in the least unlikely that an automatic machine may be designed which will be able to work out comprehensive theories explaining experimental information in any field by testing various hypotheses and drawing upon empirical knowledge. And this is what we call today truly creative activity!

This faculty, of course, belongs not to the automatic machine, but to man who has designed it. You cannot possibly conceive of an automatic machine divorced from man. Any machine, including automatic, is but the brain child of man. But it can help man in his brainwork by extending and raising it to a level which defies our imagination.

Electronic computers have shown how far man can rely on them for the performance of operations based on formal logic. Indeed, it has been a kind of revelation for specialists to find out how wide the field of formal logic extends and how complex the processes are which hitherto were the domain of the human brain, but which now lend themselves to automation with the advent of digital machines.

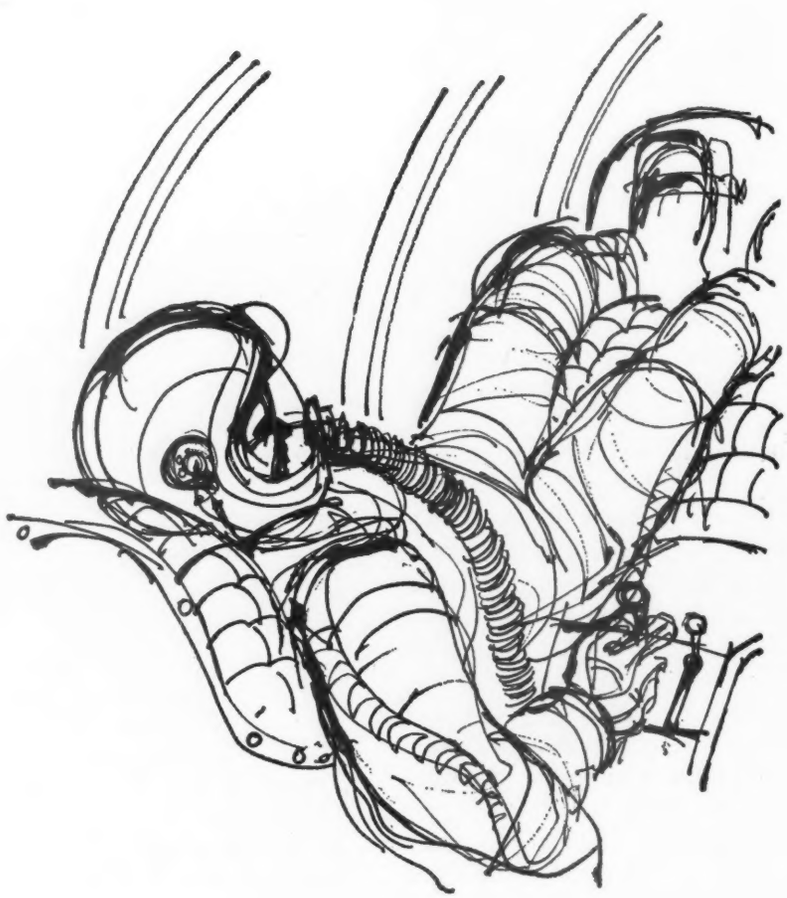
Machine translation and programing of problems which would seem to belong to the human brain, such as chess problems, have convinced many that formal logic, that is, thinking which can be programed, is much wider in scope and plays a far bigger role that it was customary to believe. Where do the limits of such possibilities lie? How wide is the field of brainwork which can be handled by automatic machines? Is this field limited to processes which can be reduced to an algorithm, or does it extend far beyond? We take an optimistic view of such things and hope that automation holds an unlimited promise as a helper of man in his mental activity.

In effect, automation plays a noble role here, for it is relieving the human brain of routine work on an ever larger scale to offer man inexhaustible opportunities for creation and aesthetic endeavors.—END

The above is condensed from the translation of the keynote address by an eminent Soviet scientist to the International Congress on Automatic Control, convened in Moscow earlier this year.

Explaining science to the layman is no light task, especially for the scientist, who often has trouble when he attempts to simplify by analogy those complicated formulae. A patient science reporter here shows how difficult it is for the professors as they try . . .

CLEARING IT UP ABOUT *RELATIVITY*



ALEXANDER DOROZYNSKI

"RELATIVITY," the Scientist told the Inquiring Layman, "has become indispensable to modern science. Yet, it is surprising how few people have the slightest idea what relativity is about.

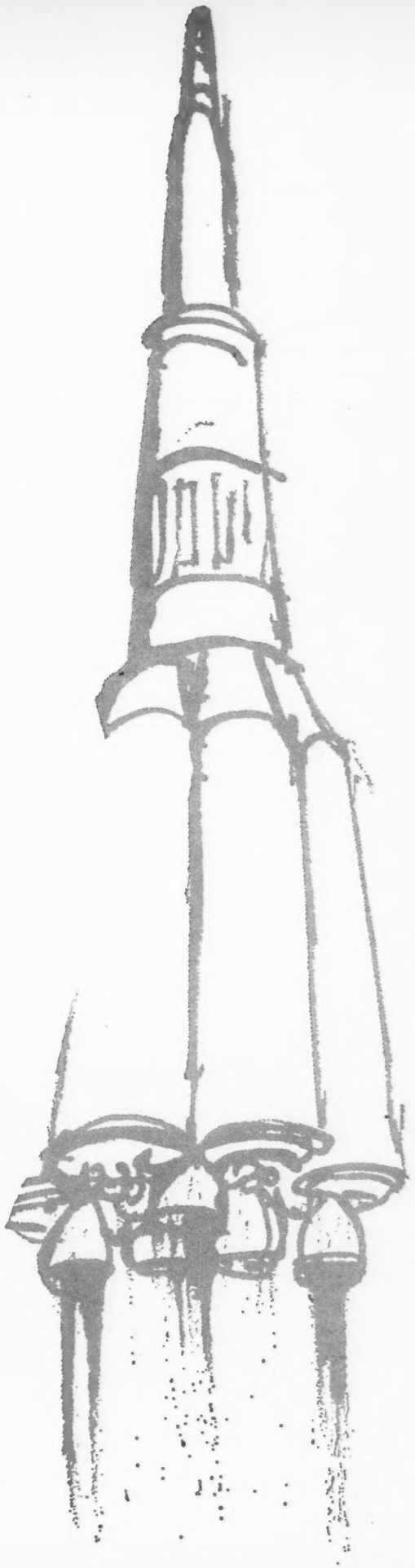
"Its formulation and acceptance have been as important as, say, the realization that earth is round. We just can't do without relativity. Some of us will go as far as to reject a new theory because it might interfere with Dr. Einstein.

"For instance, when the antiproton was discovered a few years ago, the possible existence of an antigravitational antiuniverse was hypothesized by several physicists and astrophysicists, until someone pointed out that such a hypothesis was not compatible with relativity. Hence, science has turned thumbs down on antigravitation and decided that if an antiuniverse exists, it will be attracted to rather than repelled by the universe."

The Layman was curious but, as befit him, docile. "Just what," he asked humbly, "is relativity?"

"Einstein formulated two theories of relativity," the Scientist explained. "First, the special theory, and later the general theory, an expansion of the former. Incidentally, Einstein did not receive the Nobel Prize for either of these, but for describing the photoelectric effect.

"The special theory of relativity gives an objective description of the universe, that is, a description that does not result from a single observation yet agrees with the synthesis of all possible observations. This was Einstein's famed *Gedank* experiment, the re-creation in his mind of conditions in the universe. The foundation of the special theory was that the velocity of light is constant in relation to any observer, no matter how the observer or the source of light move. That velocity is 186,000 miles per second, and would remain the same even if the light came from a car moving at 100,000 miles per second. The velocities are not additive, as they would be in a Newtonian universe.



"In Einstein's own words, this was the only way he could select a universal yardstick:

"In order to give physical significance to the concept of time, processes of some kind are required which enable relations to be established between different places. It is immaterial what kind of processes one chooses for such a definition of time. It is advantageous, however, for the theory, to choose only those processes concerning which we know something certain. This holds for the propagation of light *in vacuo* in a higher degree than for any other process which could be considered.

"The *general* theory of relativity describes measurements that might be made by observers who are accelerated in relation to each other, rather than moving at a uniform speed, as in the special theory. In the general theory, Einstein arrives at the unity of the nature of acceleration and gravitation, known as the principle of equivalence, and expands the concept of a space-time continuum where time becomes a part of geometry.

"The similitude between acceleration and gravity is widely accepted today, even by those who do not think about it and do not concern themselves with relativity. For instance, when one speaks of acceleration, one expresses it in units of gravity, and one tries to find out how many "Gs" of acceleration man can withstand as he is launched into space. Gravity machines—centrifuges—actually create acceleration, which again is interpreted as gravity.

"Einstein felt that the universe could be understood as a whole, rather than through a number of theories loosely related to each other. In the last few years before his death, he was concerned with creating a 'unified field theory,' which would, in one mighty sweep, include electromagnetic phenomena, gravity, acceleration, time, and space. In other words, a theory explaining not only why you do not drift into space when you stand on earth, but also why you don't sink through earth's molecular structure. But Einstein did not succeed and some scientists doubt that such a unified theory is possible."

"To be more precise," asked the Layman, "what are the effects described by Einstein's theories that disagree with Newtonian laws?"

"Sorry," said the Scientist, "I don't have the time to go over that. However, there are several popularizations written by scientists that may give you an idea of relativistic effects. Were you a mathematician, I would suggest you read Einstein."

"Thank you," said the Layman.

Since he was not a mathematician, he selected for his enlightenment the works of such articulate scientists as physicist George Gamow of the University of Colorado, who formulated the theory of radioactive decay; James A. Coleman, chairman of the physics department at the American International College, Springfield, Mass.; Lloyd Motz, associate professor of astronomy at Columbia University and a fellow of the Royal Astronomical Society; Nobel-Prize-winning philosopher and scientist Bertrand Russell; H. Bondi, mathematician, professor at King's College in London, and a Fellow of the Royal Society.

The Layman had already noted that the most popular Einsteinism was the relativistic "time dilatation effect," which, he now discovered, was clearly expressed by the formula:

$$t = \frac{t^1}{\sqrt{1 - v^2/c^2}}$$

He was surprised how easily the formula could be interpreted by a layman: it shows that as an object's velocity (v) approaches the velocity of light(c), time aboard object (t) slows down in relation to time (t^1) as ticked off by a clock that is stationary. In his book, *One, Two, Three . . . Infinity,* Gamow gives the now classic example of a young man traveling from earth at 99.99999999 percent of the speed of light, on his way to Sirius for lunch. "If you are in a hurry," says Gamow, "and start for home right after lunch you will, in all probability, be back on earth in time for dinner. But you will find on arriving home that your friends and relatives have given you up as lost in the interstellar spaces and have eaten 6,570 dinners without you."

"Now here," thought the delighted Layman, "is a good, clear illustration of a fundamental Einsteinian effect. And who said scientists can't express themselves?"

The Layman next undertook Coleman's work, *Relativity for the Layman,* where, in connection with the same time dilatation formula, the author says, ". . . All motion is relative, so we can readily view the space trip as if the rocket stood still but the earth went off in the opposite direction on a voyage through space and back. The theory now says that the time processes on earth will be slowed down relative to those in the rocket." Thus, according to Coleman, if you think of the earth as moving away, when it "returns" to the rocket, everyone on earth would be only one day older, and it will be the man in the rocket who will have eaten 6,570 dinners (if his algae hold

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out), while his friends on earth will have downed a single lunch. While Coleman grants the validity of the time dilatation formula, he says any permanent effect is canceled out when the ship's velocity changes during launching and landing.

Bemused, the Layman sat back, mulling the contradiction between Gamow and Coleman. "Either there is a relativistic effect as one moves at a speed close to that of light, or there isn't," he thought. "Or is it possible that relativity is relative to the observing scientists? Yet, each of them is so positive. . . ."

He saw his misfortune at being ill-equipped in mathematics. Willy-nilly, he set regrets aside and pursued his quest for relative truth.

In the astronomy classes given by Professor Motz, he heard the general theory of relativity explained thus: "Take two windowless elevators. One of them is motionless in the absence of gravitation, the other one is falling in a gravitational field. In each of them is a scientist, observing various objects as they float freely about him." (Here Professor Motz aptly sketched on the blackboard two windowless elevators, in each of them a scientist observing various objects as they floated freely about him.) "There is no way," Dr. Motz continued, "for the scientists in the elevators to determine whether they are falling in a gravitational field or standing still in the absence of such a field." Professor Motz also pointed out that in another set of elevators, one being accelerated at a constant rate while another is motionless in a gravitational field, both men and objects would stick to the floor but there would be no way of telling which elevator is moving and which is not, which is in the gravitational field and which is being pulled upwards.

"What a clever way to explain the equivalence of gravity and acceleration," mused the Layman, forgetting for a while his troubles with the time paradox.

Next, however, he happened upon a recent edition of the stately *Illustrated London News,* where, as if by design of fate, ran an article by Professor Bondi of King's College, London, entitled, "The Law of Gravitation." "Where," wondered Bondi, "does the true nature of gravitation show itself? Consider," he answered himself in his discussion of the general theory of relatively, "a free-falling box [like an elevator! thought the quick-minded Layman] falling through a shaft passing from the surface of the earth through its center. Inside the box there will be conditions of weightlessness; but, as Einstein points out, if we examine conditions there [in the box] very, very closely, then we will indeed find some evidence of earth's gravitation. Consider two particles that were [suspended] at rest on opposite [walls] of the box before the box started to fall. They are each falling freely toward the center of the earth. Therefore, by the time the box passes through the center of the earth, these two particles will collide in the box. Thus there is a tiny bit of gravitation that we cannot abolish by living in a free-falling box."

Having already experienced a relativistic conflict when dealing with the time dilatation effect, the Layman was not undone; he merely took mental note that there seemed to be a Bondi-Motz disagreement. Where is equivalence, he wondered, if, after all, one *can* tell the difference between falling down and being gravitation free, and likewise between gravitation and acceleration?

Seeking a way out of confusion, the Layman turned to the Experimentalist, who, though sometimes classified by scientists a notch below themselves in the scientific social register, had a solid reputation for clarity.

For many years the Experimentalist had been engaged in a pursuit referred to as "proving relativity." Actually, the Layman reflected, a theory cannot be proved, only disproved, and what the Experimentalist did was to design tests which would show results compatible either with Newton's laws, or with Einstein's, but not with both, thus pointing out the difference between classical physics and relativity. Dropping an ashtray onto the floor, for instance, would "confirm" relativity, but it would also confirm Newton's laws, leading to no useful conclusion. On the other hand, tests confirming Einstein but giving results not predicted by Newton had been made even before the birth of relativity; such was the Michelson-Morley experiment in 1881 (twenty-four years before relativity) which showed that if, as was often thought, some sort of "ether" filled interplanetary and interstellar space, there was no way of detecting it, and that the velocity of a beam of light emitted on earth was neither sped up nor retarded by the velocity of earth's motion around the sun. (This experiment was recently re-created with a million-to-one accuracy by Professor Charles Townes of Columbia University. Professor Townes used a maser, in which vibrations of ammonia molecules act as a pendulum in a highly precise atomic clock that can measure time with an error of something like one second in 300 years.)

"I think I may be of some help," said the Experimentalist upon hearing of the Layman's plight.

"First, let's take the time dilatation effect. It has been confirmed by the observation of the vibration of hydrogen atoms. As the atoms are shot through a particle accelerator at a speed near that of light, the vibrations slow down to the extent predicted by Einstein.

"Unfortunately, we have not yet been able to test either Gamow's illustration or Coleman's objection, because while an atom can to some extent be compared to a space traveler, it was not possible to tell whether our atoms were rejuvenated during their rapid journey. I am, however, now planning a conclusive test—sending an atomic clock (similar to a maser) in orbit around the earth, and bringing it back. If the clock when it comes back runs behind a similar one that remains on earth, the time paradox will be solved. Scientists generally believe that when the traveling clock returns to earth, it will again be running *at the same rate* as the stationary one, but will never catch up with time lost in space. Professor Coleman is believed to be in error and the time paradox to be a fallacy, since it is possible to tell which system moves and which stays put by observing which is subjected to acceleration."

Impressed, the Layman asked, "Have you also tested the general theory of relativity?"

"Yes, to a certain extent," said the Experimentalist. "You are interested in the principle of equivalence. Only last April Harvard physicists Robert V. Pound and Glenn Rebka reported 'weighing' an X-ray beam. The experiment showed that X-rays undergo a frequency shift as they move vertically from one gravity zone to another, as Einstein predicted they would."

"What does a frequency change have to do with the equivalence of gravity and acceleration?" wondered the Layman.

"Simple," answered the Experimentalist. "Atoms closer to earth are in a stronger gravitational field than those further away. In terms of equivalence, this means that they are being accelerated at a higher rate. Thus, following the time dilatation effect, time for them will be slowed down, as will be their vibrations."

"What then," the Layman murmured, "should I conclude if I am in a windowless elevator?"

"A rather difficult experiment," said the Experimentalist, "since it should be noted that the elevator must be no larger than a point in space. You wouldn't fit into it. The elevator example may be a good illustration, though it lacks the precision that so elegantly distinguishes Einsteinian effects from Newtonian ones. You have noticed when reading about Professor Bondi's particles drifting toward each other as they approach the center of gravitation, that the situation must be examined 'very, very closely.' If you do this in an elevator, you will not observe the principle of equivalence, as it applies to single particles only. Mathematical formulations cannot always be visualized. Did you try to visualize Einstein's four-dimensional but finite universe with bumps and troughs in its space continuum? If not, Bertrand Russell's *The ABC of Relativity* is the only book I know that explains why you may use a live eel, as well as a steel ruler, to measure distances in Einstein's universe."

The Experimentalist paused for a moment. "It is often difficult to understand Scientists," he continued. "Either they cannot talk to Laymen at all, or they oversimplify. We Experimentalists . . ." but he didn't finish the sentence.

So the weary Layman rested in his search for relativistic truth. Mathematical illiterate that he was, he felt he had grasped as much of relativity as he ever would. Also that he had learned something about scientists, about scientist-authors, and about experimentalists.

Still missing, however, from the Layman's list of "proven Einsteinisms," was the law expressed by the well known relativistic limerick, even then running through his mind:

There was a young fellow named Fisk
Whose fencing was wonderfully brisk
So fast was his action
The Fitz-Gerald contraction
Reduced his rapier to a disk,
the effect of

$L=L^1\left(\sqrt{1-v^2/c^2}\right)$, a formula describing the shortening of objects as they dash through space. The contraction has yet to yield to the Experimentalist; will he ever, wondered the Layman, be able/To find a young fellow so brisk,/Whose name will also be Fisk?—END

Alexander Dorozynski, who has written frequently on scientific subjects in this country and abroad, was a Fellow in Columbia University's Advanced Science Writing Program in 1959-60. The above is reprinted with permission from the Summer 1960 issue of the Columbia University Forum.

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Speaking of SPACE

WILLIAM LEAVITT
Associate Editor

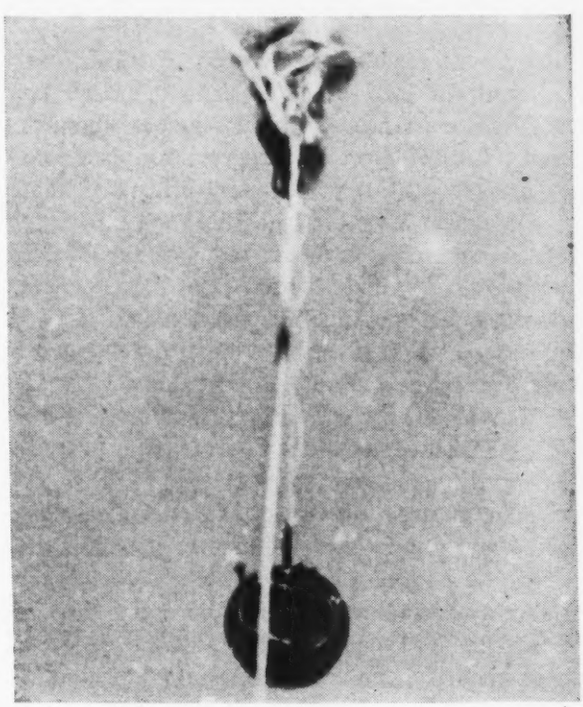
One for All or All for None?

Astronautics has its editorial hazards. By a matter of hours it was impossible to include in last month's space here the two remarkable follow-ons to the mid-August American recovery of the Discoverer XIII capsule. On the heels of that significant US "first" came the successful midair interception of the Discoverer XIV capsule by the Air Force Ballistic Missile Division *and* a reminder that the Soviets—busy as they are in the Congo—had by no means given up their interest in space technology. Almost devilishly, they dampened the spirits of our space party by announcing the safe recovery from orbit of two dogs guided back to Soviet soil at what was described as 6.2 miles from a preselected impact point.

By the time this is read, new advances, on either or both sides of the Iron Curtain, may have been attained. There will have been a new US attempt to orbit the moon and relay back American photos of the far side with an Atlas-boosted vehicle. This is basically a repetition of the 1959 US try at this very complicated maneuver, which was cruelly dubbed as a "space turkey" last year after its Thanksgiving Day failure. Also we may have recovered *our* first animal from orbit. Rhesus monkeys have been in training at the Air Force's School of Aviation Medicine at Brooks AFB, Tex., for space assignments for some time, and Lt. Gen. Bernard A. Schriever, Commander of the Air Research and Development Command, has indicated that one of the upcoming Discoverers will carry a monkey. And of course a Russian may have beeped to the world from orbit.

Photos courtesy of USSR Magazine

Belka and Strelka—first terrestrial creatures to be safely recovered from orbital flight. On August 20, the Russians announced they had safely reentered and guided to a point 6.2 miles from a preselected ground-impact area an orbited capsule containing the two specially trained dogs.



Notable US "first"—midair recovery of the Discoverer XIV capsule by airmen of the Air Force Ballistic Missile Division August 19 over the Pacific. Red's recovery of their "zoonik" occurred the following day, dimming some of the luster but not any of the pride of American space achievers.

"Orbital scatter" is proposed communications system in which signals would be bounced off rings of tiny hairlike (see left) *metallic particles fired into and scattered in polar and equatorial orbits. Concept, announced by MIT Lincoln Lab, was developed by W. E. Morrow, Jr., of Lincoln Lab and Harold Meyer of Thompson Ramo Wooldridge Corp.*

It is interesting to note that the Discoverer program, which has for more than a year contributed enormously to needed knowledge of space vehicle orientation, stabilization, transit in polar orbits, and now to the ultimate question of safe recovery, is carefully segregated, at least officially, from the National Aeronautics and Space Administration's Project Mercury program to place a US Astronaut into orbit and safely bring him home.

Obviously, data that has been gleaned in the Discoverer series is being fed into the Mercury program; it is inconceivable that close cooperation between the Air Force and NASA is not continuous. If it isn't, then we are truly defeated by our own bureaucracy.

Yet, to satisfy an Administration philosophy of compartmentalization, Discoverer is described as strictly a military program and Mercury as a civilian program. It is not uncharitable to suggest that perhaps our total man-in-space program might be rolling along a bit more rapidly and smoothly had all the talent marshaled by the Air Force for Discoverer and by NASA for Mercury been banded together in one task force in the first place. But the decisions that created today's dualism were made in those dim days a few years ago, when obvious courses of action were shunted aside in favor of a glut of committees and new offices of this or that.

The Mercury project has been sharply criticized lately—and unfairly so—on the grounds of slippage in it's schedule and because, it is charged, the man-carrying nose cone isn't really as good an approach to orbital flight as the manned skip-glide approach. It is easy from the safety of a typewriter to quote, as some have, unnamed Mercury Astronauts as anxious to go with less assurance of safe return than NASA is planning for. The Astronauts, since the program was announced, have been in the public eye, and their impatience if accurately reported, is understandable.

By the same token, the arguments for the superiority of a Dyna-Soar approach to manned orbital flight are convincing. This writer once heard one of the most deservedly famous contributors to space medical knowledge complain with irritation that putting a man in a "sardine can" over which he would have little real control, as opposed to giving him a real piloting opportunity as he returned from orbit, was not a very good idea. But it can be written with certainty that the same critic would never consider—no matter how many Russian manned spaceships might be in orbit—sending an Astronaut into orbit in the "sardine can" he disapproved of without nearly total assurance of safe guided-from-earth return.

Possibly the best recent analysis of Project Mercury—its problems and potential—was contained in a staff report of the House Committee on Science and Astronautics. The report suggested that, with the manned nose cone approach, we were putting all our eggs in one basket, and that our eggs might get broken that way.

But having put all our eggs in one basket, as far as the near future of manned orbital flight is concerned, would it have been too daring an idea to have mobilized all the requisite talent under a military leadership where *both* the national security and scientific aspects of manned spaceflight could have received needed attention?

Instead, talent has been dissipated by the policy of segregation of military program and civilian program. Rivalries and recriminations continue, despite the assurances heard repeatedly before congressional committees that "on the working level, there's no real conflict." Technical people are human, and a space scientist who has in the past several years worked in the same general capacity

Thor-Delta launches payload toward 900-mile orbit

At altitude, satellite is released, inflates to 100-ft. diameter in two seconds

"Project Echo" satellite in orbit, ready to reflect radio signals from NASA transmitters on earth

New plastic moon lets all our scientists share in satellite tests

Your voice may "echo" around the world as a result of this cooperative Space Age project . . .

"Project Echo," National Aeronautics and Space Administration's satellite launch, comes like a "windfall" research grant to scientists.

The aluminum-coated plastic sphere went into orbit folded inside the nose of a Douglas *Thor-Delta*. Researchers have been invited to further their own experiments with the aid of radio signals bounced off the satellite by NASA transmitters. Data on the orbit and signals is being widely publicized by NASA in the belief that "cooperative tests" can result in new civilian space research advances.

Such satellites may one day be used as global relay stations for radio, voice and TV signals. While this system is not a reality, the booster that can put it up already is. Douglas *Thor* has proved itself successful in 87% of its space firings. This dependable launcher is another product of the imagination, experience and skill Douglas has gained in nearly 20 years of missile development.

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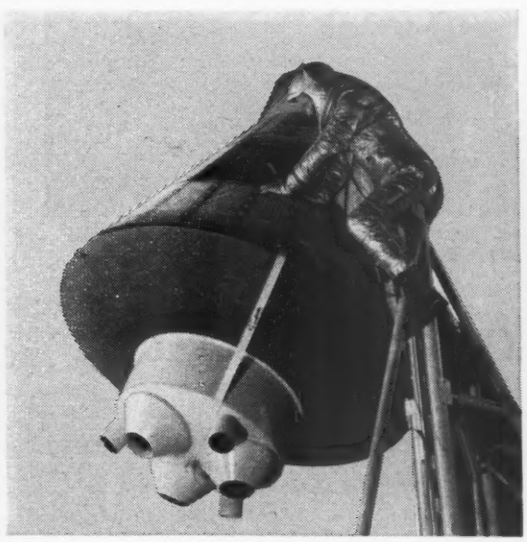
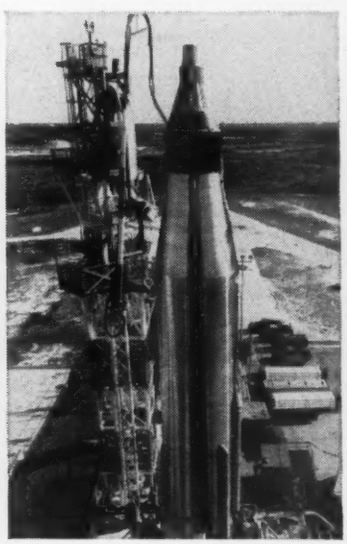


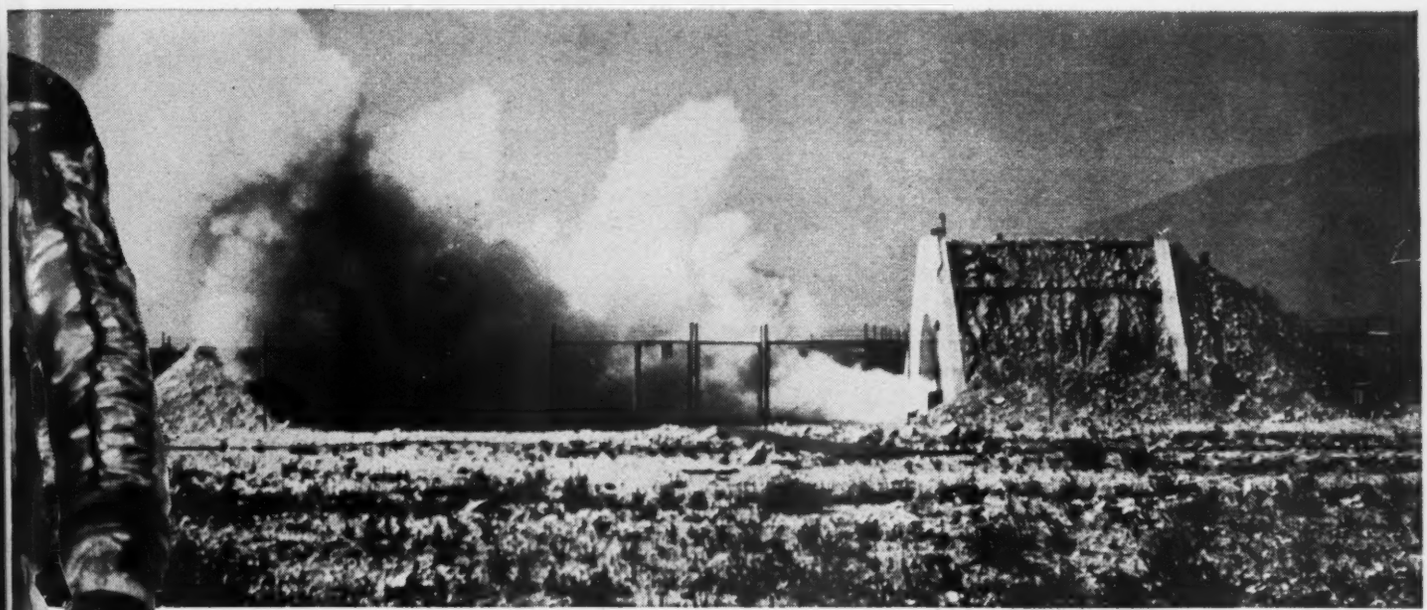
Mock-up of Project Mercury capsule, built by McDonnell Aircraft Corporation for the manned orbital flight program of the National Aeronautics and Space Administration.



In "Big Joe" test launching, full scale model of Mercury space capsule was boosted 100 miles high atop this Air Force Atlas missile. Capsule was protected by a B. F. Goodrich laminated glass fibre and resin heat shield fabricated under subcontract to General Electric.

SUITING UP THE ASTRONAUTS The pressure suits to be worn by the Astronauts are now being fitted by B. F. Goodrich. This suit must maintain enough pressure to keep a man's blood from boiling, must provide air to breathe, must protect against searing heat. In the bargain, this pressure suit is light weight and flexible enough to allow free movement.

HIGH ENERGY SOLID PROPELLANTS This static test stand is one of 56 specialized facilities at the B.F.Goodrich solid propellant plant...currently processing and loading solid fueled motors of the LOKI, RTV and ASP types. BFG pioneered the development of the major polymeric binder-fuels now being used in the most advanced missiles.



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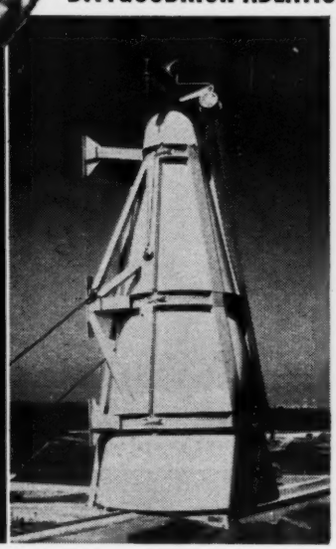
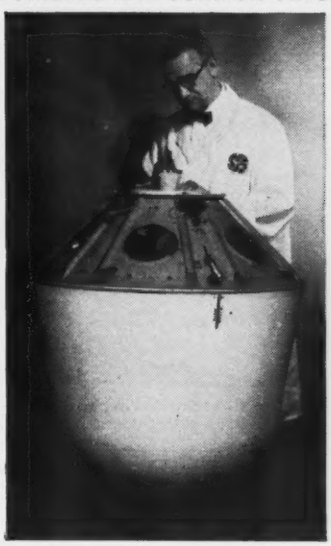
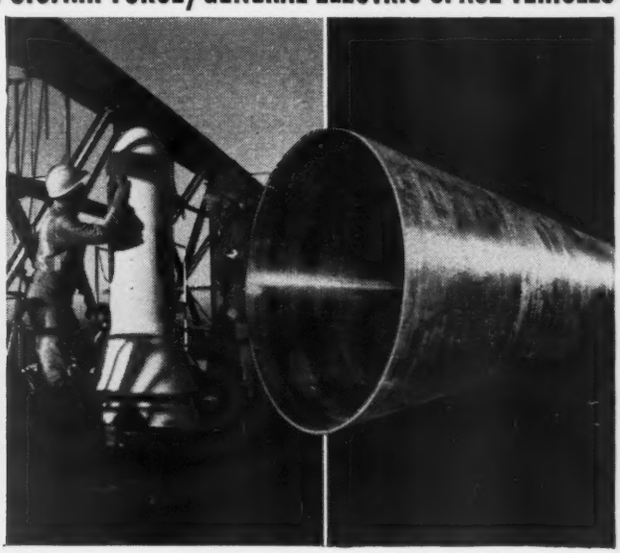


RVX-2 Re-entry/Recovery Vehicle, the largest ablation-type re-entry vehicle to travel full ICBM-range and be recovered.



Satellite Aeromedical Re-entry/ Recovery Vehicle for USAF Discoverer Program.



Mark-3, an advanced operational-type re-entry vehicle for the Air Force Atlas.

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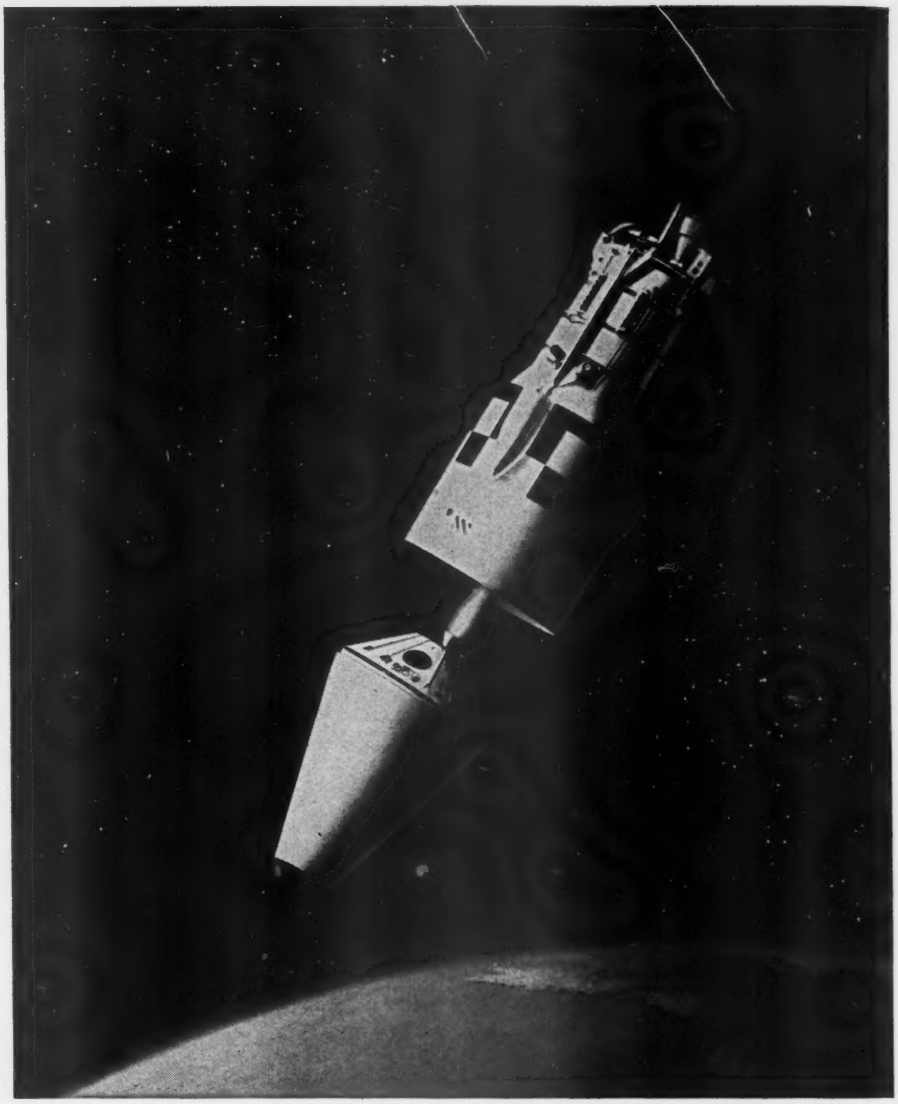
TO SPACE AND BACK!

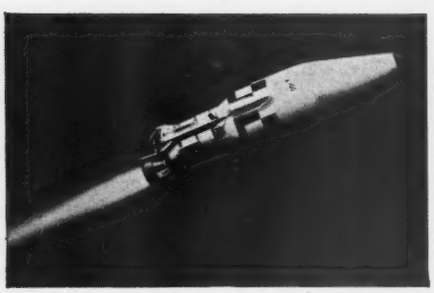
America's Agena is first orbiting satellite to send a capsule back from space



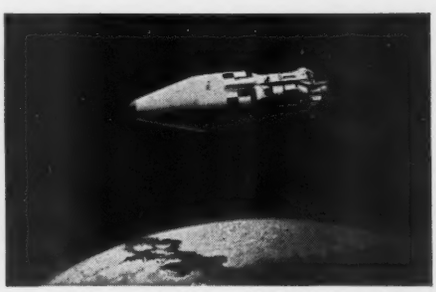
On August 11 a Lockheed-built Agena satellite gave America a monumental "first" in the race to conquer space. With perfect timing, it dropped its payload into a recovery area near Hawaii.

This brilliant feat, verifying the recovery technique, could not have been accomplished without the spadework already done by earlier Agenas in the Discoverer program of the U.S. Air Force. The Agena was first to be put on a predetermined orbit, a nearly circular orbit, and the difficult polar orbit; first to be commanded, monitored, and maneuvered on orbit; first to stabilize itself at an exact angle to earth; first to eject a recovery capsule. But the Discoverer program's most important achievement has been to provide the Air Force with a tested satellite for its vital Midas and Samos programs.

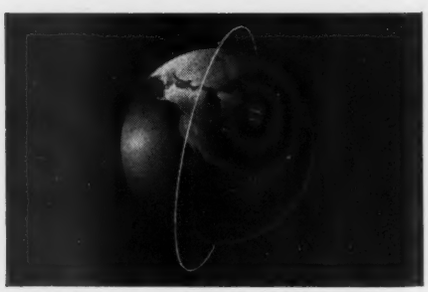
A larger, more powerful version, the Agena B, will be used in the satellite, lunar, and deep-space programs of the National Aeronautics and Space Administration for several years.



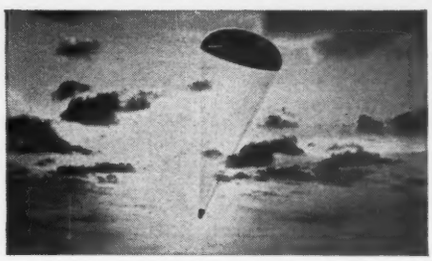
1. After first-stage Thor booster dropped away, Agena satellite's own rocket engine ignited and drove it to exact speed to reach its planned polar orbit.



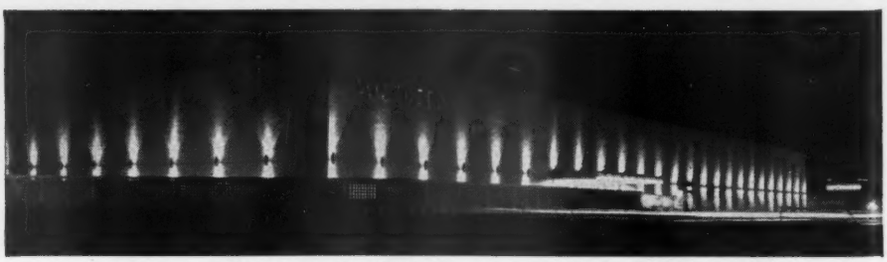
2. As soon as it reached its orbit, the Agena satellite swung itself around 180°, so that it sped tail first on its 18,000-mph, 94-minute journey around the world.



3. During the Agena's 17th pass around the earth, a timing device triggered gas jets that tilted its nose downward to a 60° angle for ejection of re-entry vehicle.



4. After the vehicle's retro-rocket (see main illustration) had slowed it to a safe re-entry speed, a parachute lowered the 300-pound capsule to recovery area.



5. Agenas are made at "Satellite Center, U.S.A."—headquarters of Lockheed's Missiles & Space Division at Sunnyvale, California. Lockheed is prime contractor for the Discoverer program. Subcontractors are the General Electric Co. (recovery capsule), Bell Aircraft Corp. (Agena engine), and Douglas Aircraft Co. (Thor booster).

LOCKHEED

MISSILES & SPACE DIVISION • SUNNYVALE, PALO ALTO, SANTA CRUZ, VAN NUYS, CALIFORNIA

for the Air Force, Army, perhaps the Navy, and now NASA, might understandably suffer from a confusion of purpose. It remains unfortunately true that while one group of scientific personnel chips away at one problem in one place, very often another similar group, working somewhere else, is doing exactly the same thing. Of course, their work may be "coordinated" by a top-level committee of leading authorities in the field. But how often do these committees really meet?

Although the Dyna-Soar skip-glide, truly piloted approach to orbital spaceflight did not attain the status of a US national man-in-space program, fortunately its advantages will be forthcoming as a prospective Air Force weapon system. It is fervently to be hoped that, regardless of the fanfare over the Mercury program, Dyna-Soar will get the men, money, and priority it deserves as an alternative approach.

The point being made here is that sooner or later we will have to start considering our space and technological programs from a more functional point of view. Otherwise, we will truly lose our way in the morass of proposals from the military, NASA, ARPA, and industry that has now become an almost unintelligible routing.

If we are planning for man in space, then all the best military and civilian talent available ought to be put to work under single management. If there are two basic approaches to man in space, as there seem to be, then the singly managed man-in-space task force should be split into two groups, each adequately funded and encouraged to come up with the best system based on its individual philosophy. We are told that the Manhattan Project's nuclear scientists took this double approach, and that surprisingly the method that seemed to have the lesser promise was the one that paid off. Such daring today seems almost unimaginable in a day when ideas have to be almost totally proved out before money is budgeted.

Confusion about the man in space is evident in other important areas too. Communications via space is a good example. All Americans are pleased with the success of the recent Echo satellite. It was doubless well worth the money and effort, in view of the propaganda benefits, especially internationally. But it is fair to ask whether Echo deserved all the huzzahs it has gotten. It was known before Echo that signals could be bounced off celestial bodies, and it is generally admitted that the fragile-balloon-in-space method is pretty marginal in terms of a truly operational all-purpose spaceborne communications system. Yet Echo was hailed in the US press as a great new demonstration of space communications.

Meanwhile, the need for a sizable program for spaceborne communications system continues. NASA has its group studying approaches, and the Pentagon has its group, and industry, notably the Bell System, has its group, which recently made a lengthy presentation to the Federal Communications Commission in connection with its ambitious program for a number of comunication satellites to be placed in orbit to serve burgeoning needs.

Again, there does not seem to be any centralized attention to the general problems of: (1) What does the country want and how much is it willing to spend for spaceborne communication to meet military and commercial needs? (2) What are the best several approaches to the problem? (3) How can we put the best people to work on these approaches?

Anywhere one looks this scattering of effort seems evident. One vital example is the Congress itself. Although technology is obviously the most relevant fact of our times, the efforts of several tough-minded legislators and intelligent staffs are fuzzed because there isn't a single joint congressional committee on space technology. Thus the two committees, Senate and House, make their studies, go over the same ground again and again, and occasionally in their zeal, stray into areas of inquiry that are barely within their bailiwicks any-

Once a laboratory curiosity, thermionic converters, which produce electrical power directly from a heat source, are now being produced in quantity at General Electric. Possible astronautical use of the device would be the production of power on space vehicles directly from solar radiation.

way, yet it is Congress which appropriates the money, and must know the facts.

We are what political scientists call a pluralistic society. This fact is surely our greatest strength since it allows for free expression, politically and culturally. But, in an age of expanding technology, attention must be given to the requirement that we realistically examine and plan for our technological needs. Some of the old ways just won't do anymore. The freedom to discuss our wants is not the license to dissipate our capabilities.

Space Capsules

The National Aeronautics and Space Administration has issued its *Third Semiannual Report to the Congress,* a 272-page tome and an excellent reference on plans and programs of the civil space agency. For information on obtaining a copy, write to Office of Public Informatian, National Aeronautics and Space Administration, 1520 H Street N.W., Washington 25, D.C. . . . For an interesting *British-eye's view of US space programs* plus coverage of what is called "Britain's Space Dilemma"—the problem of financing an independent United Kingdom space capability—see the August 5 issue of *Flight* Magazine. . . . Two historians at the Air Force Missile Development Center, Holloman AFB, N. M., JAMES S. HANRAHAN and DAVID BUSHNELL, have collaborated on a new highly readable book, *Space Biology* (Basic Books, New York, $6.), which covers in nontechnical fashion aerospace medical problems such as *G forces, radiation, the space vehicle environment, among other facets of astronautics.* There is an excellent bibliography as well as material on the history of the space travel idea and comment on the present day impact of astronautics. . . . Two California scientists, WELLS A. WEBB of Hexcel Products, Berkeley, and DR. JAMES A. HARDER of the University, speaking at the recent meeting of the American Astronautical Society in Seattle, suggested that *rocket probes of Mars carry equipment capable of detecting and relaying back to earth possible interference or destruction by intelligent beings.* They suggest that there is considerable evidence for at least the *past* existence of intelligent life to warrant inclusion of such relay equipment. Another reason cited is that favorable times for launch to Mars occur only about once every two years. Thus, if contact were lost with a 1962 probe, we would have to wait until 1964 for another decent chance at getting Martian information. . . . *"Bionics*—described as the *art of applying knowledge of biological systems to the solution of engineering design problems*—received a scholarly going-over at Dayton, Ohio, in mid-September at a USAF Wright Air Development Division sponsored symposium featuring presentations with titles like "Brain and Transducer Physiology," and "Attitudes toward Intelligent Machines." . . . What he considers the *too-slow pace of NASA's timetable for nuclear propulsion in space* was criticized in a recent statement by REPRESENTATIVE EMILIO Q. DADDARIO, Democrat of Connecticut, and a member of the House Committee on Science and Astronautics. "We have . . . talked with officials of the Atomic Energy Commission on the general subject of nuclear propulsion in space. . . . The AEC believes that nuclear propulsion could be available for space work well within the decade if pushed hard enough. NASA, however, has set its timetable on a much slower basis. I think it's wrong," said the congressman. Mr. Daddario, who has been one of the sharpest congressional questioners of national space policies in the past session, also asserts that an *unnecessary duplication of effort and waste of money will occur if NASA is allowed to set up its own life science research program* on an extensive basis. . . . SPACE TECHNOLOGY LABORATORIES is producing an excellent periodical *Space Log* containing a handy pocket listing of vehicles in orbit plus basic astronautical data. Volume I, Number 1 came out in July. Write JOHN HERRICK, Editor, Office of Scientific and Engineering Relations, Space Technology Laboratories, Inc., P.O. Box 95001, Los Angeles 45, Calif., for details on availability. . . . MARGARET MEAD's provocative article on "The Newest Battle of the Sexes," published in the July SPACE DIGEST, was inserted in the *Congressional Record* during the last days of the "bob-tailed" session of Congress.

The massive proceedings of last June's *National Convention on Military Electronics,* which contains considerable technical data on space applications of electronics, has been released and is available at $5, from the Professional Group on Military Electronics, Institute of Radio Engineers, 1 E. 79th St., New York 21, N. Y. . . . For twenty-five cents science teachers anxious to stimulate interest in science fair participation among their students can get some good ideas and bibliographical suggestions by writing to *Space Science,* 4211 Colie Drive, Silver Spring, Md. The little pamphlet has chapters on: The Teacher and the Space Sciences; The Space Sciences in the Science Fair; Conducting a Star Party; and The School Astronomy Club.—END

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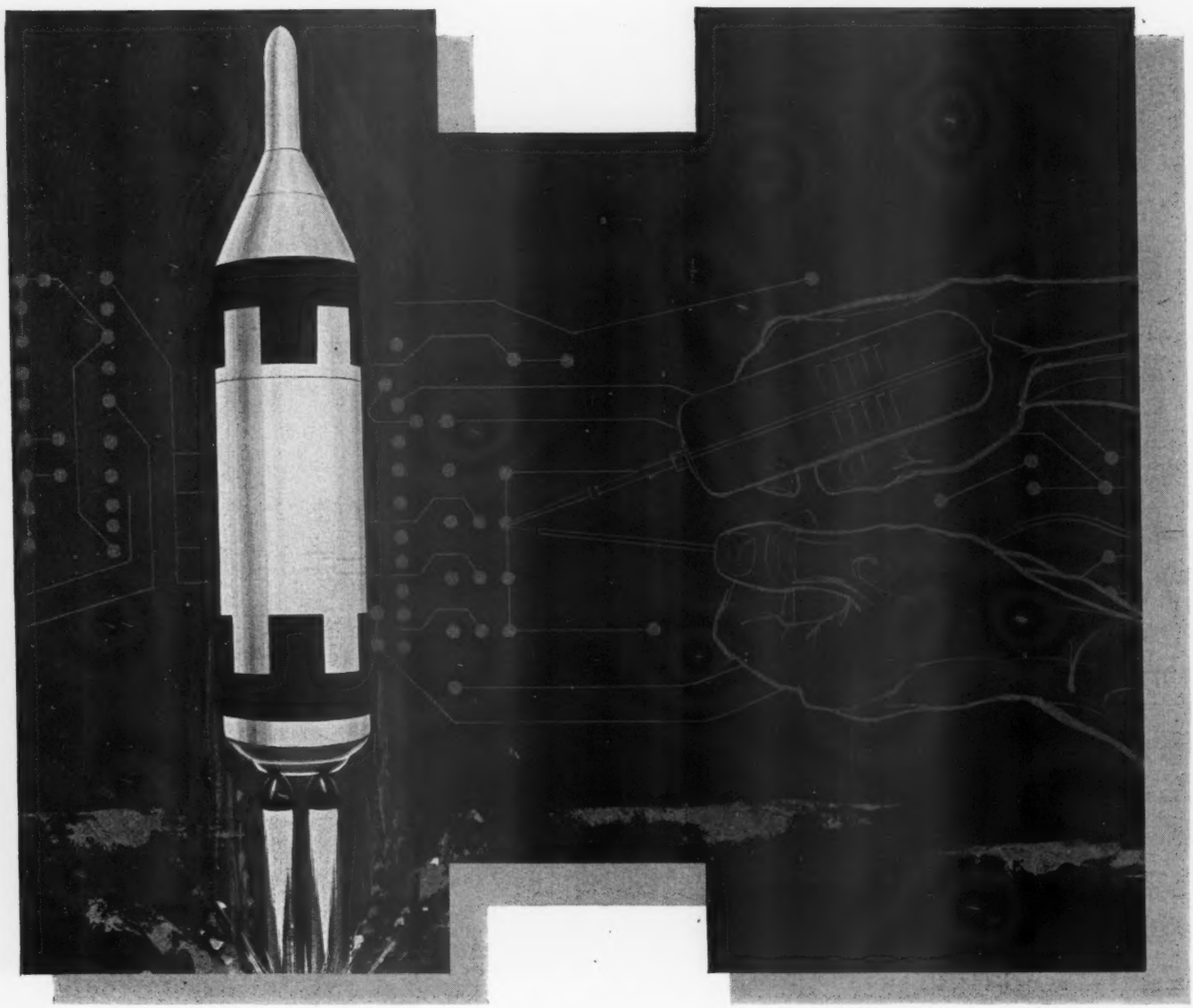
Putting Polaris on a precision



path

Newest of Hughes' many guidance developments is the advanced system for the Polaris. It is designed around a unique computer which directs the missile's course on information received from a precision inertial platform.

Now in production at Hughes, the Polaris guidance package withstood life tests of better than 1500 hours.

Yet it was not until last February that the real mettle of the Hughes-manufactured Polaris computer was demonstrated. In its first flight test, the Hughes computer worked perfectly.

But Hughes' guidance systems are not restricted to inertial types. Drawing on its experience in the development of infrared-guided Falcon missiles and radar-guided Falcons, Hughes is today working on new applications in these areas.

Three factors account for the successful Hughes record in guidance: the high degree of creative freedom given to Hughes engineers, Hughes' outstanding electronics manufacturing facilities and the intensive training which Hughes Field Engineers bring to the field problem.

Like other Hughes electronics systems and components, Polaris guidance is a product of Hughes' unique capabilities in virtually every area of advanced electronics. These include projects in space systems, airborne control systems, microwave communications, data processing and display systems, ASW systems, radar and IR detection systems—and many others.

These advancements in the state of the electronic art are based on foresight, imagination, and proven management capability. Their reliability and operational capabilities have earned them the confidence of users throughout the free world.

Videosonic Assembly Techniques, *developed by Hughes manufacturing engineers, are the most important advance in production line flow since the standard assembly track. Used to build Hughes guidance systems, these techniques regularize flow, maintain reliability, and reduce worker fatigue.*

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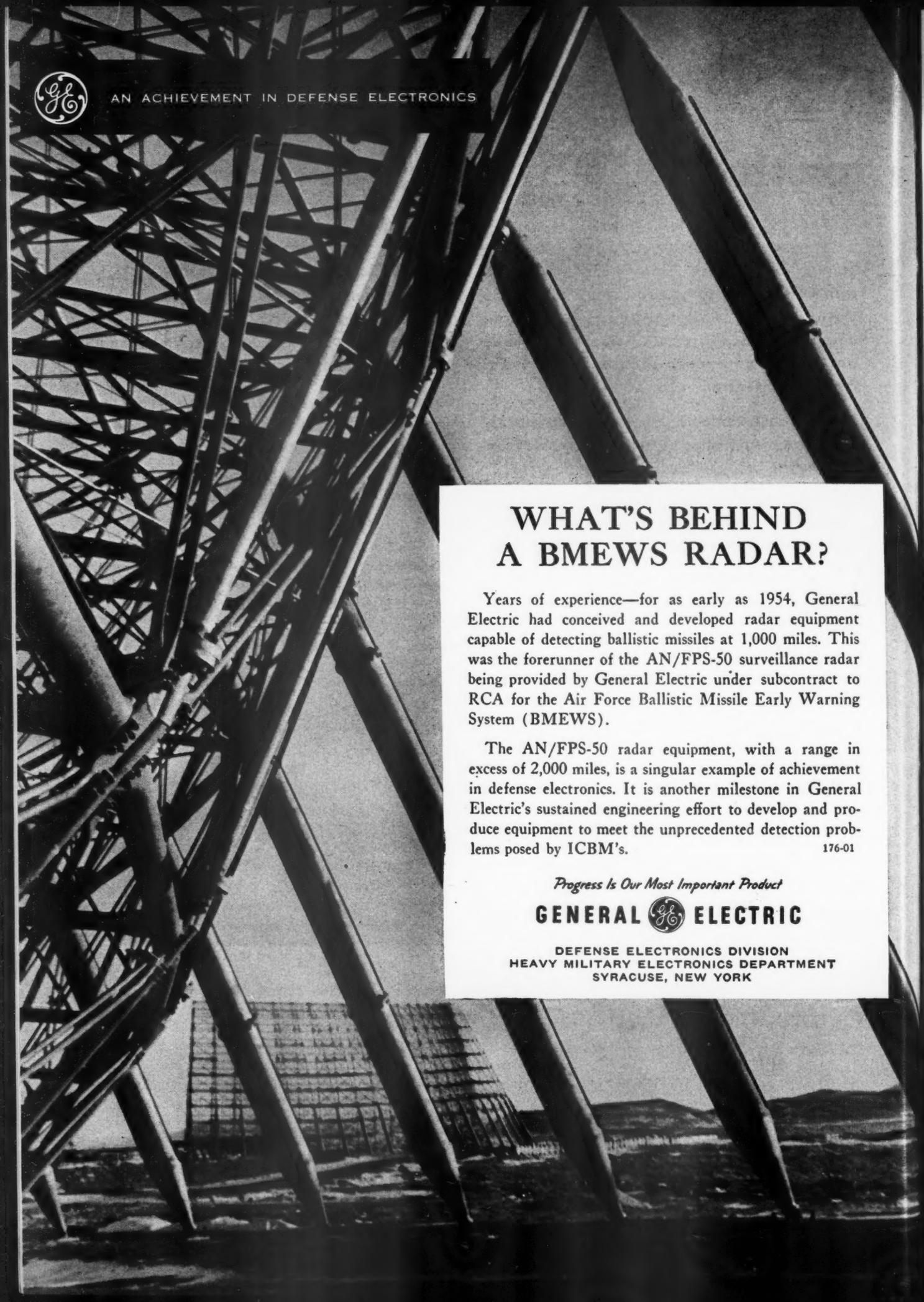

WHAT'S BEHIND A BMEWS RADAR?

Years of experience—for as early as 1954, General Electric had conceived and developed radar equipment capable of detecting ballistic missiles at 1,000 miles. This was the forerunner of the AN/FPS-50 surveillance radar being provided by General Electric under subcontract to RCA for the Air Force Ballistic Missile Early Warning System (BMEWS).

The AN/FPS-50 radar equipment, with a range in excess of 2,000 miles, is a singular example of achievement in defense electronics. It is another milestone in General Electric's sustained engineering effort to develop and produce equipment to meet the unprecedented detection problems posed by ICBM's. 176-01

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The support of man in space and on other celestial bodies may depend on current probings into the possibility of artificially adapting plant and animal life to extraterrestrial conditions. A noted scientist comments on . . .

SPACE FARMING . . .
Agriculture's New Challenge

JAMES E. GUNCKEL

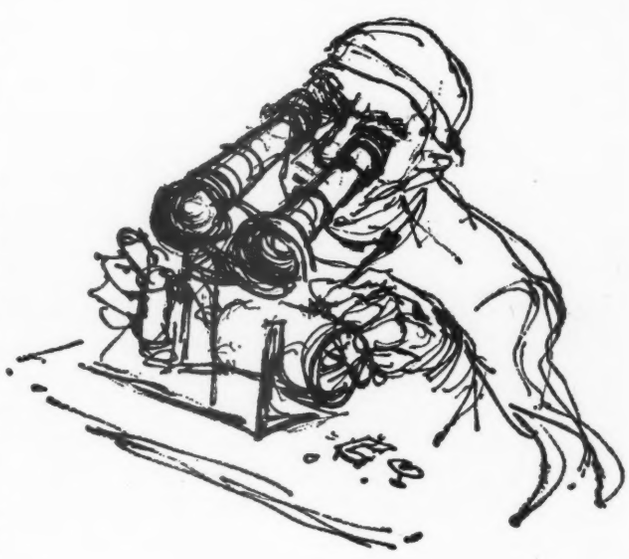
IF MAN is to escape from this planet he must either take his present environment along or adapt to a different one. The problem comes down to perhaps two alternatives: (1) ways must be devised to outfit a manned space probe or space station with the oxygen, water, food, and controlled temperature to keep earth plants and *homo sapiens* alive; or (2) over a long period we must produce a special race of plants (not so likely for animals) better suited for space life.

Much has been said and done on the possibilities of setting up a closed system (carbon cycle) where green plants would supply food and oxygen to the astronaut, who in turn would give off the carbon dioxide and water necessary to the green plants.

Several scientists have proposed that single-

Boeing biochemist, Dr. Joseph Stern, and University of Washington's Dr. Albert K. Sparks, in white coat, watch experiment in which tropical fish, in small jar at center, are grown on algae in large jar at left. The experiment was designed to explore the possibilities of providing fresh food and oxygen for spacecrews.

celled green algae, such as *Chlorella,* which have been successfully cultured in large batches in a water medium containing a few mineral salts and dissolved carbon dioxide, would be suitable to supply food and oxygen for the space traveler. A variant on algae culture was recently reported. It was suggested that water fleas might be a staple in the spaceman's diet. These fleas, which grow rapidly on a diet of algae, could provide proteins, fats, sugars, vitamins, and minerals when eaten in soup, as a salad, or in a dried pellet. They were described as tasting "something like avocado with a hint of shrimp."



In selecting the best approach to this problem of a space diet we must bear in mind the concept of a *food chain.* In nature, plants are the "producers" and animals the "consumers." The efficiency of the food chain depends upon the number of steps (middlemen) between the primary

In satellites and ground equipment, RCA space systems set outstanding performance record.

With its third consecutive satellite success, RCA Astro-Electronics Division has made "reliability" meaningful in space systems engineering and development. Read the "Reliability Record" for yourself.

December, 1958: Project SCORE. AED developed the communications and control systems for the U.S. Army Signal Corps' "Talking Atlas", part of a program under ARPA, Dept. of Defense. Transmitters, receivers and control units in the satellite and at the ground stations all operated perfectly as the "Talking Atlas" broadcast the President's Christmas message and proved the feasibility of active communications satellites.

April, 1960: TIROS I. The sophisticated satellite, including its structural design as well as the electronic systems, and its ground stations were developed and built for NASA by AED under the technical direction of the U.S. Army Signal Corps. It accomplished its mission in meteorological observation, sending down over 20,000 TV pictures of earth and its cloud cover.

August, 1960: Project ECHO. The only electronic equipment on this 100-foot balloon, launched by NASA to prove the feasibility of passive communications satellites, are two "dinner plate" beacon transmitters 10 inches across by ⅜ inch thick, including storage batteries and solar cells. These units, designed to permit beacon tracking of the satellite, weigh only 11 ounces apiece and were developed and built by AED.

As more and more sophisticated space systems are developed, AED will continue to design for reliability in this most demanding of all environments. To find out how you can draw on this dependable R&D capability, contact the Manager, Marketing, RCA Astro-Electronics Division. If you are interested in participating in this challenging team effort, contact the Employment Manager, Astro-Electronics Division, Defense Electronics Products, at RCA's "Space Center" in Princeton, N. J.

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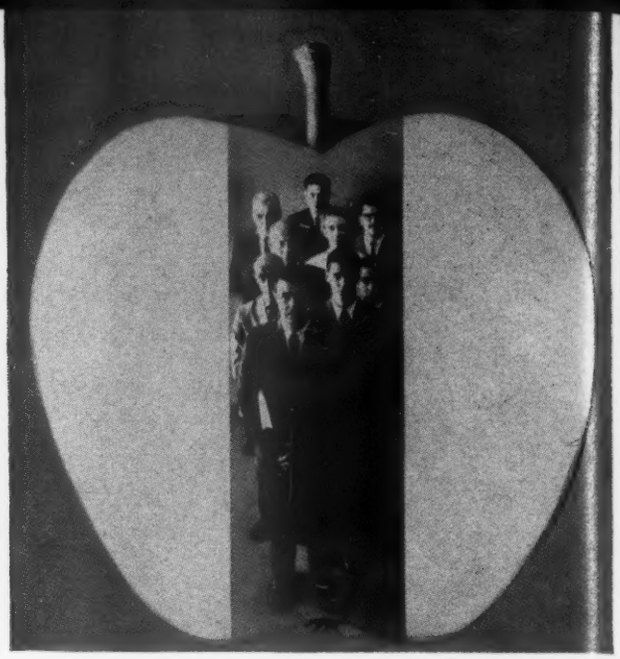
POINTS OF DEPARTURE



"CORE CONCEPT"—NEW APPROACH TO SYSTEMS MANAGEMENT AT S-C

A basic problem in Systems Management has grown out of the one-shot nature of each project. In many cases, after the system is delivered, the team dissolves. Then, when a new Systems project is initiated, the process of assembling a Systems team starts all over. This consumes time, effort and money.

We've done something about this at Stromberg-Carlson. We've created a new approach to Systems Management.

We call it the Core Concept.

We've built a *permanent* managerial staff. Because it is permanent, we've been able to bring in top talent in engineering, supervision, research, accounting—men with the ability and experience to handle major projects simultaneously or successively.

in SYSTEMS MANAGEMENT

And we've also assembled a group of prime capability sub-contractor companies—*in advance of systems proposals*. As a result, we are able to get projects off the ground faster, to carry them to successful completion with a minimum of lost time or effort—*at a lower cost to Government*.

Right now, in fact, Core Concept is speeding the development of the On-Site Titan Command System and of a new, highly classified ground passive reconnaissance system, to name two of Stromberg-Carlson's Systems Management assignments.

As a leader in electronics and communications, we're qualified to take over additional systems management responsibilities in undersea or CBR warfare, command control systems, and related areas.

Why not let our Systems Management people show you how Stromberg-Carlson's "Core Concept" can be put to work on your program?

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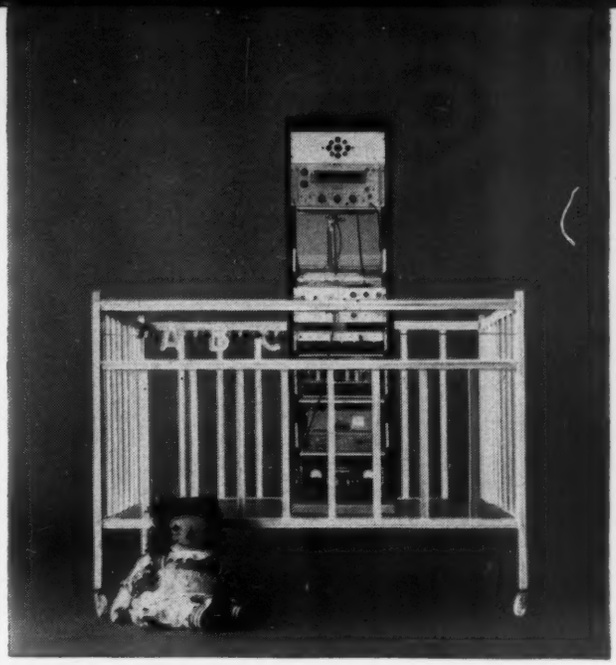


THIS BREADBOARD IS LEARNING TO TALK... AND LEARNING FAST

No, it's not an exotic loudspeaker or other transducer we're aiming for in research at Stromberg-Carlson. It's an electronic device that can turn a coded signal into actual speech. Why?

Well, by encoding your voice for transmission along a channel many magnitudes narrower than that occupied by the original speech sound wave... and by synthesizing this signal back into speech at the other end... we can cram many messages into a given circuit capability, frequency range or bandwidth.

This program demands probing beneath classical phonetics into the very psychological and physiological mechanisms of human communication. It requires mathematical analysis of speech patterns, and it calls for new computer logic.

in COMMUNICATIONS RESEARCH

Already, this research program is well advanced. This year we should complete analysis equipment and partial analysis of speech signals.

A machine that speaks is only one of Stromberg-Carlson's current objectives in research. A random sampling might spotlight such projects as these: Studying and evaluating solid-state materials and devices to meet the requirements of specific radio frequencies. Adding to our basic knowledge of data transmission in order to increase speed and reliability, at lower costs. Enhancing our knowledge of thin magnetic or dielectric films and their application to high-speed access storage systems. Tailoring solid-state molecules into super-sophisticated circuits or circuits not previously possible. In short—we're interested in anything that will lead to a better understanding of electronics and communications—terrestrial, maritime, or celestial.

HOW TO ELIMINATE 99 OF EVERY 100 MINUTES IN SYSTEMS TESTING

SCATE—Stromberg-Carlson Automatic Test Equipment—is just what the weapons system engineer ordered. It is very likely the most advanced, and fastest test equipment available today.

Programmed with punched Mylar tape, SCATE tests an unprecedented number of parameters, makes marginal and contour tests, isolates specific faults, detects performance degradation, predicts probable sources of failure, continuously checks itself, displays a rapid HI-GO-LO and numerical evaluation for each test and prints a permanent record... all in record-breaking time.

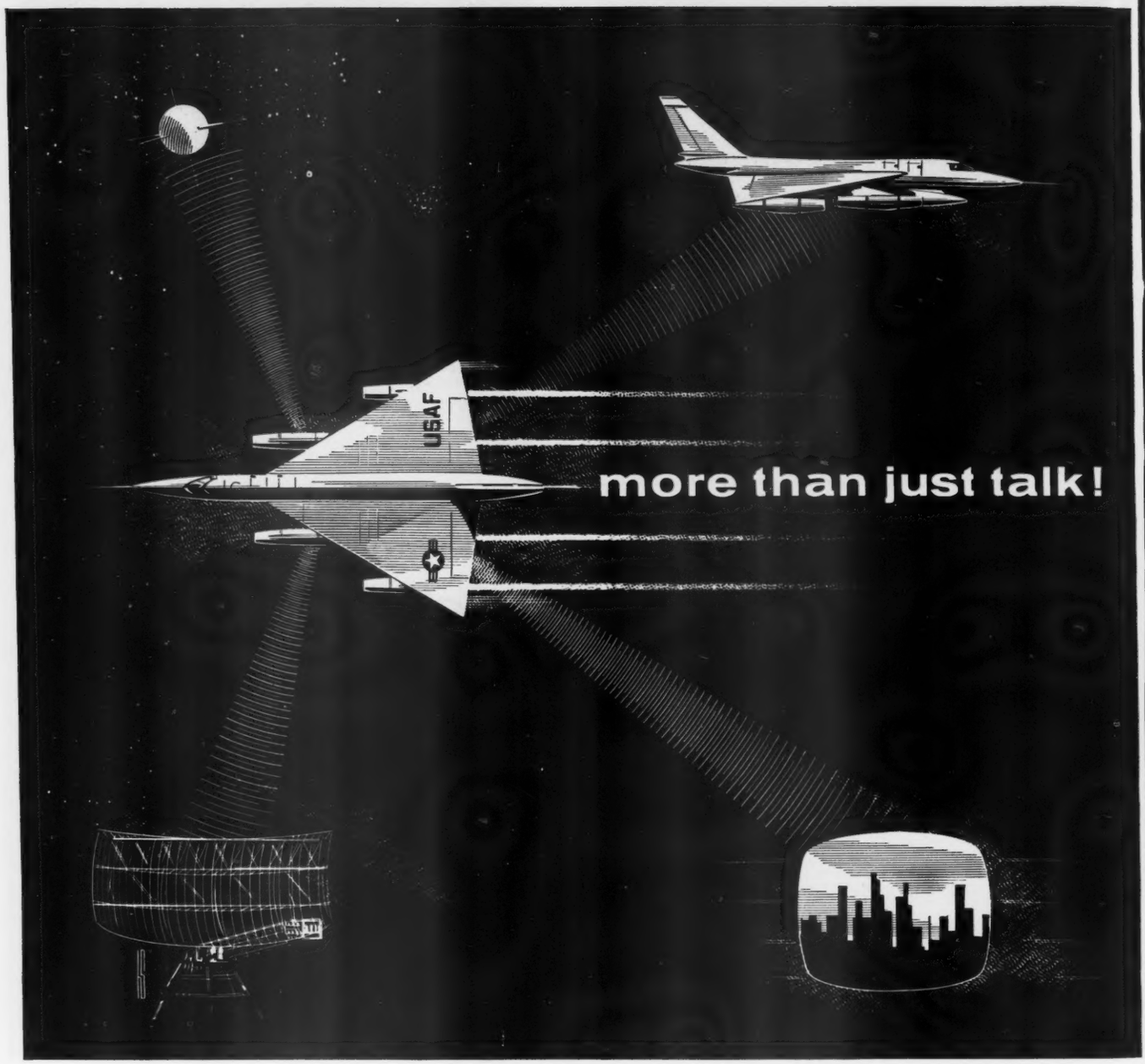
SCATE pays off in flexibility and economy, too. Standard building-blocks—solid-state modules using proven, reliable circuits—form the nucleus of the

in ELECTRONIC EQUIPMENT

basic SCATE system. Unique blocks—special stimulus generators and response normalizers—custom-tailor SCATE to the particular test requirements of any missile, aircraft or ground electronic system. And that old bugbear of test equipment—development changes in weapons systems—is no problem at all. Substitution of certain modules keeps SCATE up-to-the-minute, matching any weapons system from prototype to operational status.

Speed? 7000 bits per second. Recently, in a classified area, SCATE reduced a 12-hour manual testing program to less than 5 minutes. This represents a time reduction of over 99%.

In sum, SCATE is the only automatic test equipment that delivers these four critical advantages: (1) fault isolation, (2) self-testing, (3) complete solid-state modularization and (4) in-development flexibility. Descriptive literature on request.

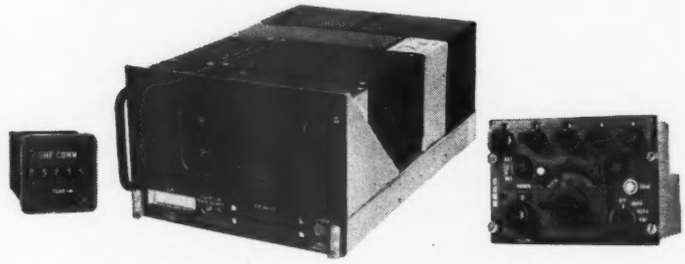


Magnavox continues to maintain a position of leadership in the airborne communications field.

Magnavox engineering, in conjunction with the Air Force, has developed an advanced airborne communication system that is designed to meet the requirements of the future. Utilizing wide band techniques, such functions as television relay for bomb damage assessment, data link for control and identification, and many other forms of air-to-air and air-to-ground communications can all be realized over the same equipment as used for voice.

Magnavox

AN/ARC-50 SYSTEM



COMMUNICATIONS | RADAR | DATA HANDLING | ASW | MISSILES

THE MAGNAVOX CO. • DEPT. 307 • *Government and Industrial Division* • FORT WAYNE, IND.

producer and the final consumer. The common marine food chain illustrates the point: diatoms (algae) (billions)⟶ copepods (shellfish) (millions)⟶ herring (thousands)⟶ man (hundreds).

Two things are illustrated here. First, the microscopic plants suitable as "producers" must be provided in enormous numbers to sustain higher forms of life. The problem of culturing these numbers in a relatively small space with the greatest efficiency and least weight is formidable. Second, and most important, the more middlemen between producer and consumer, the less efficient the process. That is, each member in the food chain must carry on his own life processes. Hence, because each step consumes an appreciable amount of food energy from the original source, less and less is available for the next consumer.

Finally, the psychological problem of satisfying the appetite of a space traveler with a dried pellet instead of a good sizzling steak may be as difficult as setting up a self-sustaining system.

Actually, the closed system may be the wrong approach. Should free flights be achieved, the speeds available make even an extended space probe a matter only of days or weeks, during which food concentrates would be adequate.

On the other hand, the provisioning of a space station or base on another planet seems a more likely project.

Agriculture is a little better prepared for this one. While refrigerated meat and dairy products could be flown in, a supply of fresh vegetables would be highly desirable. This supply could be grown in a liquid nutrient culture where mineral salts dissolved in water are recycled throught a bed of sand, gravel, or cinders. This type of culture method was successfully used by the armed forces in the Pacific during World War II, as on Ascension Island. Even here, however, we need to know more about the effect of various physical factors in plant growth, especially, in this case, the effects of various kinds of radiation on plant growth.

While it is possible, even probable, that life exists elsewhere, it is likely to have evolved differently than what we know. Certainly most planets in our solar system lack an atmosphere containing oxygen and water, or are too hot or too cold to sustain life as we know it.

Might it not be possible to develop forms of plants (possibly some animals) better adapted to living on other planets, rather than trying to transplant our current models with their requirements adjusted to earth's conditions? Assuming a positive answer to this question, to what conditions should we try to adapt and how?

Probably our astronomers would need to survey each prospective space-station site and provide an approximation of the conditions to be met as a guide to tailoring plants (and animals) to live there. For our working conditions we might consider the conditions on this planet when life first evolved.

Our planet was initially much warmer, the atmosphere was quite different, and cosmic and ultraviolet rays and natural radioactivity were strong forces. Along these lines the experiments of Miller and Urey are most interesting. They passed an electric current through a vial of this presumed primeval atmosphere—water, methane, hydrogen, and ammonia—and produced simple amino acids, the building blocks of proteins. In nature a similar event may have occurred, with lightning or the energy from atomic radiation acting as the unifying force.

New life probably originates continually in this way but does not get a chance to develop because of the antibiotic materials now present in the environment. That is, once evolved, many plants secrete protective substances to prevent competition from other forms of life. Working under sterile conditions, however, it may be possible to produce new forms of plant life adapted to various environments.

Another possibility for retailoring plants to live on other planets lies in which we might call "retrogressive evolution." This has indeed been done experimentally with horses. Here life forms slip backward into more "primitive" forms through new genetic combinations under different environmental conditions. For example, every population has a broad spectrum of variation in which certain individuals are better equipped to survive in a particular environment than others. Change the environment, however, and recessive characters, those not usually seen in the population before but are carried along in the genes, will be expressed and have survival value in the new environmental situation.

Once a new environment has been provided, successful new forms will appear from the old population. For example, when DDT was first introduced as an insect spray it was highly effective, but one fly in a million was resistant. Now, much of the fly population is highly resistant to DDT alone. Similarly, some antibiotics have been used so widely, perhaps indiscriminately, that

certain bacteria are not only immune but also some even require the antibiotic for growth.

Finally, an example highly pertinent to the present discussion. Plants and animals without the atmosphere screen would be subjected to radiation so intense as to inhibit growth or even produce aberrant growth. Living things in space would need to survive high-energy radiation. Dr. H. H. Smith of the Brookhaven National Laboratory has produced a tobacco hybrid that is not adversely affected by irradiation but, in fact, must be irradiated with ordinarily lethal, high-energy gamma rays before it will flower and develop.

Now as to methods for accomplishing these changes. Cross-breeding of different plant species (hybridization) introduces variation into the population so that a changing environment will select adaptable individuals. Another possibility is to produce mutations (chromosomal or gene changes) by treatment with heat-cold, chemicals, radiation (X-ray, ultraviolet, cosmic rays, gamma rays, thermal-energy neutrons), sonic vibrations, dehydration, etc.

An intriguing new possibility has just been announced by a team of Harvard scientists. The chromosome material or genes is made up largely of DNA (deoxyribonucleic acid) usually in the form of a double coil. By heating this material and slowly cooling, this team uncoiled the two strands, rearranged the material, and put it back together without harming its properties. By micromanipulation it is possible to remove the nucleus DNA from an egg cell and transfer it to another without harming the cell. Perhaps it would be possible to take out the DNA from the nucleus, rearrange it, and return it to the cell. The particular expression of the genes depends upon their linear arrangement in these double-coiled strands. Change the arrangement (a mutation) and the expression is different. Mutations occur normally very, very infrequently. The hope is to enormously speed up the process of change.

The plant researcher is interested, depending upon the crop, in developing more stem and leaves for fodder, better yield of fruit, disease resistance, better size and quality, hardiness, earlier ripening, hybrid vigor, favorable mutations, etc. All of these goals are being attained by conventional methods but powerful new tools are available.

Subjecting plants to relatively low doses of continuing ionizing radiation has proven effective in producing *somatic mutations,* changes in the developing bud of the plant. In this way the Somatic Mutation Program at the Brookhaven National Laboratory has produced a superior red carnation, an early-ripening peach, improved blueberry and strawberry varieties, and apple sports [mutations], still to be evaluated. These improved forms are then propagated by cuttings. Seed treatment by X-rays or gamma rays or thermal neutrons greatly accelerates the rate of *gene mutation.* By this method a rust-resistant variety of oats was developed in about four years, while conventional breeding methods might have required twenty-five to thirty years. Thermal-energy neutrons in particular should be exploited more for the induction of mutations.

Ionizing radiations in food preservation have numerous potential applications. These include sprout inhibition of stored potatoes, onions, carrots, etc., retardation of ripening of various fruits, and sterilization of plant products. While radiation sterilization of foods to be stored at room temperature has been worked out successfully in a few cases, the results are discouraging so far for meat and dairy products. Until further developed there is a possibility that adverse changes in taste, texture, odor, or nutrient value may occur.

The direct stimulation of plants by continuous low dosages of ionizing radiation has been reported by several investigators. However, it is hardly practical to grow commercial crops in a "gamma field," where they would be exposed to radiation, as from cobalt-60, but the pretreatment of seed under special conditions to stimulate growth could be useful. The best possibility for stimulating growth may be with radioactive fertilizers. The Russians have reported increased yields of five to ten percent for certain cereal grains and vegetable crops, when fertilizers containing small quantities of radioactive materials were used. Although work in this country has not supported this contention, the matter is much too important to drop.

Many biological space problems are urgent contemporary problems. If we become complacent and stand still in any field, we shall be lost in a new Stone Age.—END

A botanist associated with atomic development since 1950 as a consultant to the Brookhaven National Laboratory, Dr. Gunckel is Chairman of the Botany Department at Rutgers University. The above article is condensed with permission from the Stanford Research Institute Journal.

Will The Mission Succeed?

Ask . . .

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Flight-line checkout by DATS (Dynamic Accuracy Test System) tells the interceptor commander whether his aircraft and weapon control systems are completely ready for a successful mission. As a result of field evaluation tests, showing the effectiveness of DATS in improving weapon control performance, RCA has been awarded an Air Force production contract. Developed by RCA's Airborne Systems Division, Defense Electronic Products, Camden, New Jersey, DATS is a new approach to the evaluation of system readiness.

It makes certain that only aircraft with properly operating weapon control systems are sent on missions. Based on a building-block design employing the highest reliability factors, a mechanical programming device and self-test capability, DATS utilizes a series of synthesized attack runs typical of mission conditions. DATS could be made applicable to many interceptor types of aircraft.

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Guidance: Key to maximum P_{ms} in space

As space technology advances, the character of space missions will become more and more sophisticated. High Pms (probability of mission success) will be increasingly dependent on precision guidance.

A major role in space guidance will be played by the gyroscope—the basic navigational reference for things inertial—and by such related technologies as space-astronautic digital computing, TV-inertial platform systems, miniature celestial inertial systems, IR sensing, and radiation resistant devices. In all of these, and in associated systems analyses such as evaluation of Pms and of overall system dynamic stability, Sperry is actively engaged.

With its unparalleled background in guidance and control over five decades, Sperry is today laying the groundwork in research, and in practical experience, for the sophisticated guidance requirements of tomorrow. Now in design or development stages are soft lunar landing and interplanetary guidance systems and controls . . . boost, mid-course, re-entry and terminal guidance . . . self-adaptive flight controllers . . . space acquisition radar systems and rendezvous controls.

These contributions to "maximum Pms" in space exemplify Sperry's overall scientific capabilities—capabilities that reach into every stratum of our environment today . . . and far into the future. General offices: Great Neck, N. Y.

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OCTOBER 1960

This summer, SAC recruited a blue-ribbon crew and conducted Minuteman missile mobility tests on rail lines in six western states. Tech Sergeant Jim Doherty, a SAC information specialist who took part in one of the historic train runs, here tells us what it was like . . .

Somewhere in Wyoming, SAC's Minuteman Missile Test Train pulls off onto a siding from which America's first solid-fuel ICBM might one day be launched. No missile was aboard this eleven-car train, which visited six western states.

WORKING ON THE RAILROAD . . . SAC STYLE

TSgt. James R. Doherty, USAF

WE CROUCH in the shade of the warehouse wall, forty-two of us—some in uniform, some out—squinting like one man at the train inching toward us down the sun-baked siding. It is nearly noon. The breeze that made the morning bearable has long since died, and the sky above Utah's Hill Air Force Base is blue, bone-dry, and burning.

Slowly, the train pulls alongside. We stand up. The air-conditioned interiors of the blistered cars look dark and inviting. But the signal to climb aboard does not come.

The man who must give it is standing alone at the edge of the loading platform. He is Lt. Col. Carleton V. Hansen, late of SAC's Arizona-based 303d Bomb Wing.

The officer turns, finally, and his grin is self-assured.

(Continued on following page)

After a moment he speaks, and his voice is friendly yet authoritative.

"Gentlemen, our quarters have arrived. If you'll be kind enough to grab yourselves a handful of Pullman car, we'll get the show on the road."

My ten-day TDY aboard SAC's Minuteman Test Train has begun. In the next week and a half, our eleven-car entourage will visit six western states. En route back to Hill AFB, our starting point, we'll explore main lines and rarely used sidings in Utah, Wyoming, Nebraska, South Dakota, Montana, and Idaho.

SAC is at work on a new idea—that mobile launching platforms for America's new, solid-fuel ICBM, the Minuteman, are feasible when Minuteman becomes operational—and that the nation's railroads can shuttle them about swiftly and effectively enough to confuse our potential enemy.

This test, one in a series, will pose a number of questions to the team of perspiring technicians now clambering aboard. How well can the Minuteman be expected to stand up under the wear and tear of rail travel? Are communications adequate between the train and its controlling headquarters? Can random movement be safely effected over existing rail networks?

To find the answers, SAC has recruited a blue-ribbon crew made up of thirty-one uniformed technicians and eleven civilians. Most boast specialties that fit very well into train operations. Some are diesel mechanics, others are electricians, communications technicians, or experts in rail transportation.

Civilian members of the squad include observers and technicians from the Boeing Airplane Company—prime Minuteman contractors—the Collins Radio Company, and other defense-associated firms. There is also a civilian group aboard representing the Association of American Railroads.

From one of the old hands, I discover that these cars are former railroad "ambulances," converted, at SAC's request, to a home on wheels for the Minuteman train pioneers.

In addition to cars for quarters, there is at least one piece of rolling stock—a "Command and Control Car," which must surely be unique in railroad annals.

In this equipment-jammed nerve center, the train commander will make his mobile headquarters. Its most arresting feature is a complete single-sideband and UHF radio station, designed for instantaneous communications between the train and the Task Force Control Center at Hill AFB. And at times Colonel Hansen well be in direct contact with SAC's underground command post at Offutt AFB, Neb.

A total of eleven cars makes up our train. Some are for the storage of water, fuel, and supplies. One is a modestly appointed diner. Another is a crew ready car, complete with TV and hi-fi sets.

Only one vital piece of equipment is missing: the big, three-stage bird, itself. But this is not a test of Minuteman hardware. That will come later.

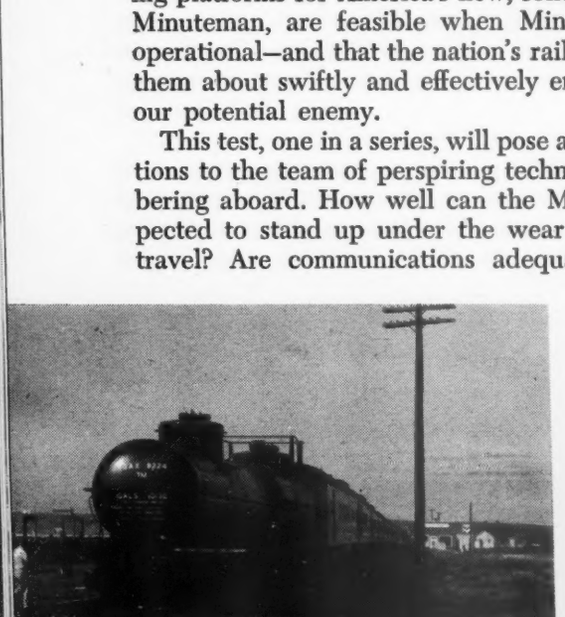
Colonel Hansen's voice sounds on the PA system: "This is your train commander. We will be departing the base in a very few minutes, eastbound over Union Pacific. To all of you: Welcome aboard—and here's hoping our trip will be pleasant and profitable. Car chiefs will please stand by to report their cars secured and all personnel accounted for."

I slip into the seat alongside my private picture window. Then, at long last, we are rolling.

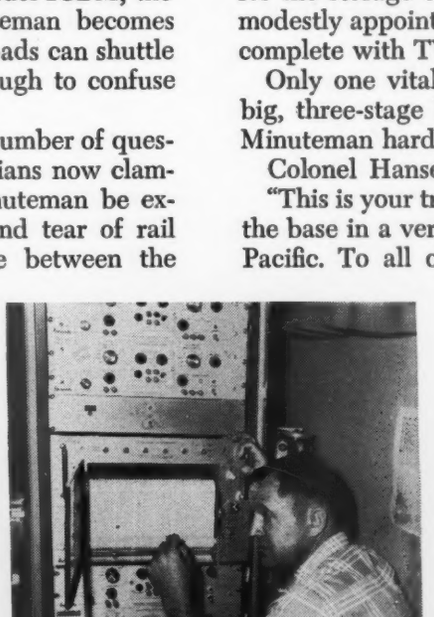
Our pace seems brisk enough. But then I look up and glimpse the graceful horizon-to-horizon contrails of a passing B-47 Stratojet. Suddenly, we appear to be creeping.

The irony of the situation is inescapable. SAC, the nation's premier dealer in aerospace, has taken a step backward in time. On the surface, that is. This return to the rails might better be termed a marriage of yesterday and the present, that may yet serve to guarantee tomorrow.

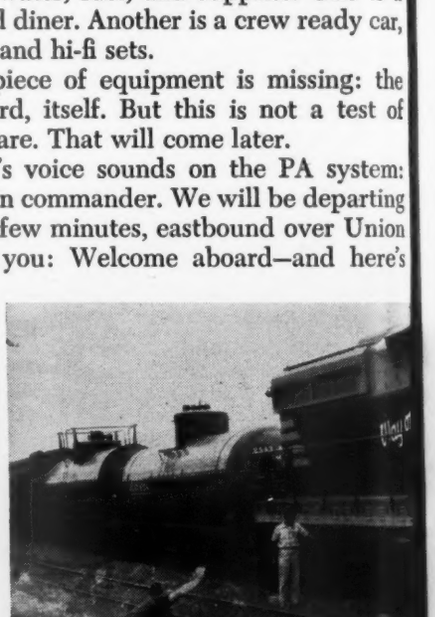
By suppertime, we are lancing across the vastness of southwestern Wyoming in the vicinity of Green River. Chow lives up to advance billing, and so does the weather.



Above, the Missile Test Train waits on a siding at Bitter Creek, Wyo. The two tank cars are to transport fuel and water. Boeing representative at the left is taking grade measurements.



Boeing engineer Boyd Barker operates the Brush Recorder aboard the Test Train, seeking information to help engineers design shock mountings for Minuteman as it travels the country.



A team of engineers from Boeing check the settling rate at this particular siding. How much the track sinks under a heavy load could affect the aiming formula for the ICBM at this site.

As I lug my steak and potatoes down the dining car aisle, I marvel at the blackness of the thunderheads stacked above the plains. When the storm breaks, it is something to see.

Within seconds after the first drop of rain is toggled earthward, the low spots in the prairie have been converted to a chain of shallow, wind-driven lakes. The thunder is an ominous drumbeat above the roar of the train.

After supper, as we sprawl on our collective spines in the crew ready car, I make the acquaintance of our train commander. Colonel Hansen, who will be forty years old less than a week after our trip ends, looks like a working middleweight, minus the scar tissue. He is prematurely gray, and his matching mustache looks as if it belongs.

During World War II, the colonel was the pilot of a much publicized Italy-based B-24, *Bucket of Bolts.* Later, he shifted his attention to the South Pacific, where he wound up as a squadron operations officer in the autumn of 1945. His log book shows a total of fifty-nine combat missions and more than 4,000 hours in the cockpit.

Colonel Hansen's job now is to verify the adequacy of the military train crew and the test train configuration to support an extended deployment. He is not ranking officer aboard. That honor goes to Col. Lucion N. Powell, who heads the entire SAC task force charged with proving the feasibility of this mobile concept.

Colonel Powell, who won his wings at Kelly Field, Tex., in 1935, formerly commanded the 5th Bombardment Wing, at Travis AFB, Calif. The day may be not far off when a fleet of elusive Minuteman trains will be shuffling around the country. When that time comes, Colonel Powell will be back-of-the-hand familiar with both the big picture and the small.

It is pitch dark when we pull into our first "RON" siding. The place: a whistle stop in the Wyoming wastelands known as Bitter Creek.

Straining my eyes against the outside blackness, I see a single light. It glows atop a two-by-four general store that comprises the settlement's entire business district.

A highlight of the evening that follows is the showing of "Third Man on the Mountain," the first of four full-length films we will ogle during our boondock cruise. The picture is a rouser, and proves excellent "OJT" for the subsequent ascent to my narrow upper berth.

At breakfast, the chow is again superb. Our food service officer, CWO Oscar B. McKinney, knows his stuff. Chief cook is SSgt. George R. Brock, Jr., who could hack it as head chef at the Waldorf-Astoria any day.

In Bitter Creek, we enjoy an hour or two of outdoor exercise. An impromptu horseshoe tournament develops, and we succeed in scratching up a number of spanking new softballs in the cindered topsoil. At noon, as a half-dozen of the hamlet's sunburned citizens look on enviously, we back onto the main line and resume our journey eastward. It turns out to be a short and uneventful run. Less than four hours later, we are bivouaced on a siding at Hanna, a division point on the Union Pacific Railroad that is but one step removed from Bitter Creek on the ladder of Wyoming way stations.

Hanna's one saving grace turns out to be a cow-pasture baseball diamond that lies within hailing distance of the tracks. The post-supper contest, which turns out to be an extra-inning affair, had to be called on account of exhaustion.

At 11:20 the next morning, Colonel Hansen starts us rolling southeast toward Cheyenne. I head for the control car, hot on the heels of the Boeing engineering team.

As prime Minuteman contractor, Boeing has assumed a vital role in the success of SAC's so-called "mobile missile concept." A company squad of at least six highly trained engineers will be aboard on all test deployments. I corner two of them in their none-too-spacious "office" that adjoins the train's communications center.

A large, dial-studded instrument that looks a good deal more ominous than its name implies dominates the room. The gadget is a Brush Recorder.

With the Brush Recorder, Boeing is detailing the acceleration, or "G" forces, that Minuteman will be subjected to as the bird is trundled about by rail.

In the train's elaborately equipped communications center, Maj. Alvin Herrewig, Chief Command Post Controller, and his assistant, MSgt. Gerald Swift, can keep in touch at all times with the Hill AFB headquarters or with Hq. SAC's famed underground command post at Offutt AFB, Neb.

Among other things, the machine's findings will influence the design of shock mounts on the missile car itself. While the train is in motion—and at odd times when we are standing still—the recorder's sensitive needles are busily tracing their nervous lines across reams of annotated graph paper.

The Boeing engineers also maintain an around-the-clock watch on a cathode ray oscilloscope, mounted in one corner of the room. The big-eared machine picks up every electrical disturbance for miles around the train, including emissions from telegraph and power lines, from the motors aboard the train, and from lightning.

After pinpointing their sources and determining the strength of such emissions, proper shielding can be devised. Their recommendations will also be useful in helping to improve the quality of radio transmission and reception aboard the train.

(Continued on page 107)

TRACKS MOVE WHERE NOTHING ELSE CAN GO

Modern concepts of battlefield tactics require a high degree of ground mobility for many new weapon systems. Whatever the requirement – missile transporter launchers – radar or communication equipment – ground support equipment – cargo vans – troop transport – all can have full mobility with one or more standard military vehicles of the new M113 family.

This family of vehicles in either armored or unarmored versions is lightweight to be airborne, amphibious to swim water barriers, tough and dependable for continuous heavy duty.

Test data is available on request concerning the shock loads transmitted to missile systems being carried under the most severe cross-country conditions.

Put your mobility questions to FMC, since 1941 a leading designer and builder of military standard vehicles.

For further information, write on company letterhead to Preliminary Design Engineering Dept., FMC Ordnance Division, P.O. Box 367, San Jose, Calif. Phone CYpress 4-8124.

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FOOD MACHINERY AND CHEMICAL CORPORATION

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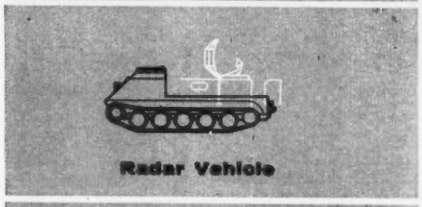
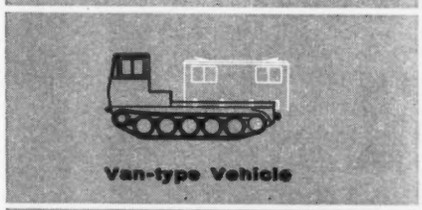
Illustrated below are the M113 and five vehicle adaptations of this basic tracked vehicle. All of the vehicles use the same military standard equipment, including engines, power train, and suspension components; thus reducing the military logistic burden and R&D costs in weapons systems.

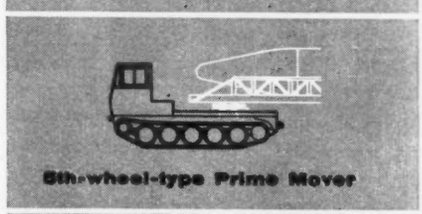
M113 Armored Personnel Carrier



Radar Vehicle



Van-type Vehicle

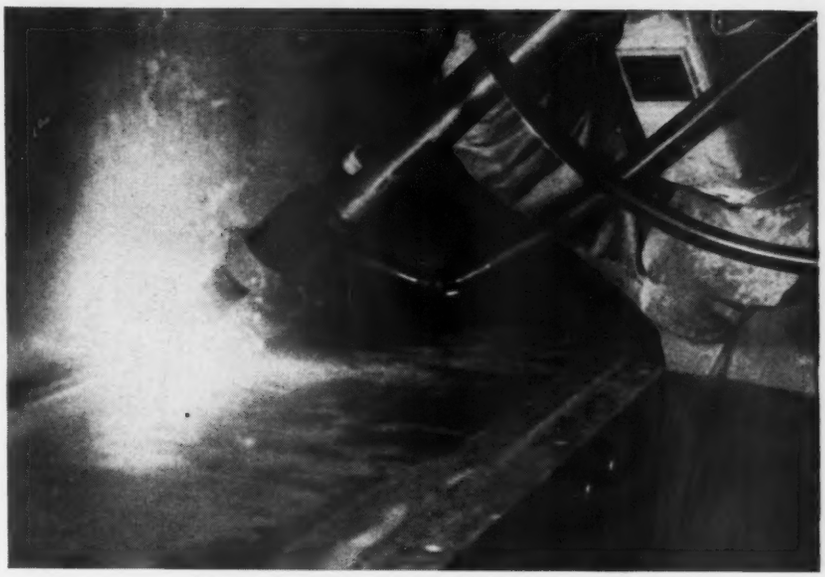


5th-wheel-type Prime Mover

Utility Crane Vehicle

Missile Launcher

FMC's Aluminum Alloy Welding Techniques Open New Horizons for Structural Applications



Machine welding heavy aluminum armor plate in FMC's Ordnance Division's shops.

Food Machinery and Chemical Corporation's recently developed welding techniques make economical heavy aluminum weldments possible. High strength, low weight, gas and liquid tight construction are a few of the characteristics available through modern welded aluminum fabrication. These techniques are ideally suited to the construction of vehicles – landing craft, barges, containers – on an economically sound basis.

FMC's aluminum welding capabilities are the result of extensive research and development work performed in cooperation with military agencies to develop reliable, economical welding techniques for the production of the aluminum M113 Armored Personnel Carrier. Thousands of pounds of various aluminum alloys were formed, welded, machined and tested to select the best alloys and fabrication methods. Over a score of prototype M113's were then constructed and subsequently tested by military agencies to substantiate the vehicle's design and construction.

The economy realized through FMC's development of welding and fabrication techniques is an important factor... making the cost of the aluminum M113 competitive with the M59, its steel predecessor. Welding costs for this all aluminum vehicle were reduced through the use of –

Optimum joint geometry
Maximum use of welding fixtures
Maximum use of automatic plate preparation equipment
Maximum use of machine welding equipment
Maximum use of extruded shapes

These modern methods and facilities may provide the answer to your problems in procuring high performance equipment.

The new aluminum welding techniques developed for the M113 program and vehicle production, illustrates FMC's fully integrated capabilities and facilities.

WE'VE GOT 'EM
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CLIFTON HEIGHTS PENNSYLVANIA

At each park site, Boeing men collect soil samples and run a battery of tests to determine the rate, if any, at which the track may be expected to settle under a standing load. Some tracks will settle unevenly, with one rail lower than the other. The peculiarity could make a decided difference in the Minuteman's final trajectory equation.

Rail alignment, the grade of a siding, and its elevation are other data that Boeing personnel are charged with gathering at every park site.

For the next three days, we rattle steadily eastward. The weather, by turns, is either comfortably cool or miserably hot—but in our moving blue oasis we could care less.

Life aboard the train settles quickly into a routine not too unlike that of the average base. As the train rolls along, the countryside gradually turns from brown to green outside our unblinking windows. We leave Wyoming behind for the gently undulating wheat fields of Nebraska.

Sometime during a wet and restless night, we turn north. The following morning we awaken on a siding near Alliance, Neb. From Alliance, we angle northeast, along a track that cuts across a corner of South Dakota and back into Wyoming. Our immediate big town port of call is Billings, Mont. By early evening, we are racing through the pleasant valley of the Little Big Horn, where Gen. George Armstrong Custer fought and died.

At Billings, we turn further to the northeast. For a portion of the night, our route parallels the Yellowstone River. Dawn is just around the bend as we jolt to a stop at the village of Forsyth. Rumor has it we will be here until noon.

Today is Sunday. Traffic will be light in the train's communications center, so I buttonhole our Chief Command Post Controller, Maj. Alvin Herrewig. He volunteers the "unclassified skinny" on this most important aspect of Minuteman deployments.

Major Herrewig, who is permanently assigned to the 1st Missile Division at Vandenberg AFB, Calif., escorts me into the closely guarded room. The place is a babble of sound. Voices crackle from a half-dozen concealed speakers. Seated at the control panel, microphone in hand, a noncom is deep in conversation with the pilot of a SAC bomber flying in the vicinity.

"What we're doing here, in a small way, of course, is simulating the operation in the usual SAC command post," Major Herrewig explains. "We monitor a number of frequencies. On occasion, we may initiate some traffic ourselves. On this deployment, however, it's being kept to a minimum.

"We learned early in the game that keeping in touch was no great problem. And there is the security angle. It would be relatively easy for a long-range direction finder to follow us about, if we were on the air constantly. It won't be a practice when we become operational, so we don't do it now."

"What about the numerous tests I hear you're conducting?" I ask.

"Much of this is classified, as you probably suspect. But I can tell you this: We're leaving nothing undone to assure that there is no place—in a tunnel, behind a mountain, beneath an overpass—where these trains will be out of touch."

We are dispatching our second cup of communications center coffee, when the train commander himself knocks for admittance.

"On our first deployment," the colonel informs me, "SAC called the shots. When we were ready to get under way, we contacted Task Force Headquarters back at Hill AFB. After getting the OK from SAC, they passed along our request to the railroad concerned.

"This time, we're doing things a bit differently. Our schedule of movement, although planned well in advance, has not been given to the railroads. When the time to get rolling approaches, I personally contact the nearest division point.

"We may give them thirty minutes, an hour—maybe even two hours—advance notice. The idea is to see just how quickly the various lines can accommodate us.

"Once we're rolling, they never know when or where we plan to stop. From the communications center here, the word is flashed by radio telephone through Hill AFB, SAC, or via whichever Air Force base we happen to be near, to the proper railroad authorities. So far, the plan has worked to perfection. In only one instance have we failed to get the exact parking spot, on the exact siding, that we requested."

In the days that follow, we clank eastward, from Forsyth to Miles City, Mont., where we do a classic one-eighty and head back west. It is evening of the seventh day when we reach Great Falls, the most northerly point along our 2,300-mile itinerary.

By now, we have traveled on more railroads than I can readily recall. Among them are the Union Pacific, the Southern Pacific, the Milwaukee Road, and the colorful Great Northern.

From Great Falls, we begin the three-day stretch run for home. On the docket is an extended layover at Hardy, Mont., followed by another in the bleak railroad town of Garrison. From the latter, it is virtually a continuous ramble, via Pocatello, Idaho, to the finish line at Ogden.

We chug into Hill AFB, back to our warehouse siding, squeaking to a stop in the midst of a train-wide "GI party" that has been going on since 6:30 a.m.

Bags, of course, have long since been packed. Most crew members are planning quick trips home before the next deployment in the series begins in a week.

In his straightforward fashion, Colonel Hansen sums up the thinking of every man aboard with his final announcement:

"Congratulations to each of you. It's been a pleasant trip, I hope you will agree. As for me, I'd do it all over again, gladly, with the same crew, anytime. Thanks—and good luck."—END

The author, TSgt. Jim Doherty, is an information specialist at SAC Headquarters, Offutt AFB, Neb. He is a veteran of fifteen years of military service, twelve in the Air Force and three in the Coast Guard. During World War II, he flew thirty-five missions as radio operator-waist gunner with the Fifteenth Air Force in Italy.

the Ready Room

RESERVE AND AIR GUARD NEWS

Pine Cone III

Pine Cone III, the biggest airborne exercise since World War II, was a mammoth success.

It teamed **500 troop carrier planes** of the Air Force Reserve with more than **11,000 Army paratroopers** of the 101st and 82d Airborne Divisions, plus an **Air Guard tactical force** that included guard units from Massachusetts to Mississippi.

The air units accomplished very nearly **every sortie laid on by the joint operations** staffs and came through without so much as scratching a wingtip. In the ground fighting the "aggressor" was, as usual, crushed.

The exercise, centered on the **Fort Bragg, N. C., area,** ran for **fifteen days** from August 13 to 28. In addition to Air Reserve and Air Guard units, **TAC and MATS contributed planes and crews** to the air operations.

Leading off the exercise, MATS hauled the **101st Division from its home at Fort Campbell, Ky.,** to eight dispersal bases in North and South Carolina and Georgia. Air Reserve airlift forces (ARALAF) under command of **Brig Gen. Rollin B. Moore, Jr.,** of California, moved into the dispersal points to prepare for the assault.

On August 20, after Air Guard tactical forces (ANGTAF), commanded by **Brig. Gen. Don Strait** of New Jer-

(Continued on page 111)

Paratroopers of the Army's 101st Airborne Division, Fort Campbell, Ky., bound for drop zone aboard an Air Force Reserve C-119 in Pine Cone III exercise in the Carolinas on August 20. Five hundred reserve transports took part.

Troops hitting the ground, collapsing parachutes after airdrop from the troop carrier planes. More than 11,000 soldiers of 101st and 82d Airborne Divisions were flown into "battle" during exercise. They crushed "aggressor."

Controllers at work in Air Traffic Control Center, Pope AFB, N. C., during Pine Cone III. Air National Guard tactical forces swept the skies clean and pummeled the enemy in exercise. Foreground, a Georgia ANG controller.

C-123 brings in equipment for "friendly" force on August 20, main air assault day of two-week exercise. Planes, landing on dirt strips in drop zone, brought in 500 troops, 400 tons of cargo following reserve aerial drops.

The Later Years

People look to you for guidance, respect your executive position, honor you for your achievements.

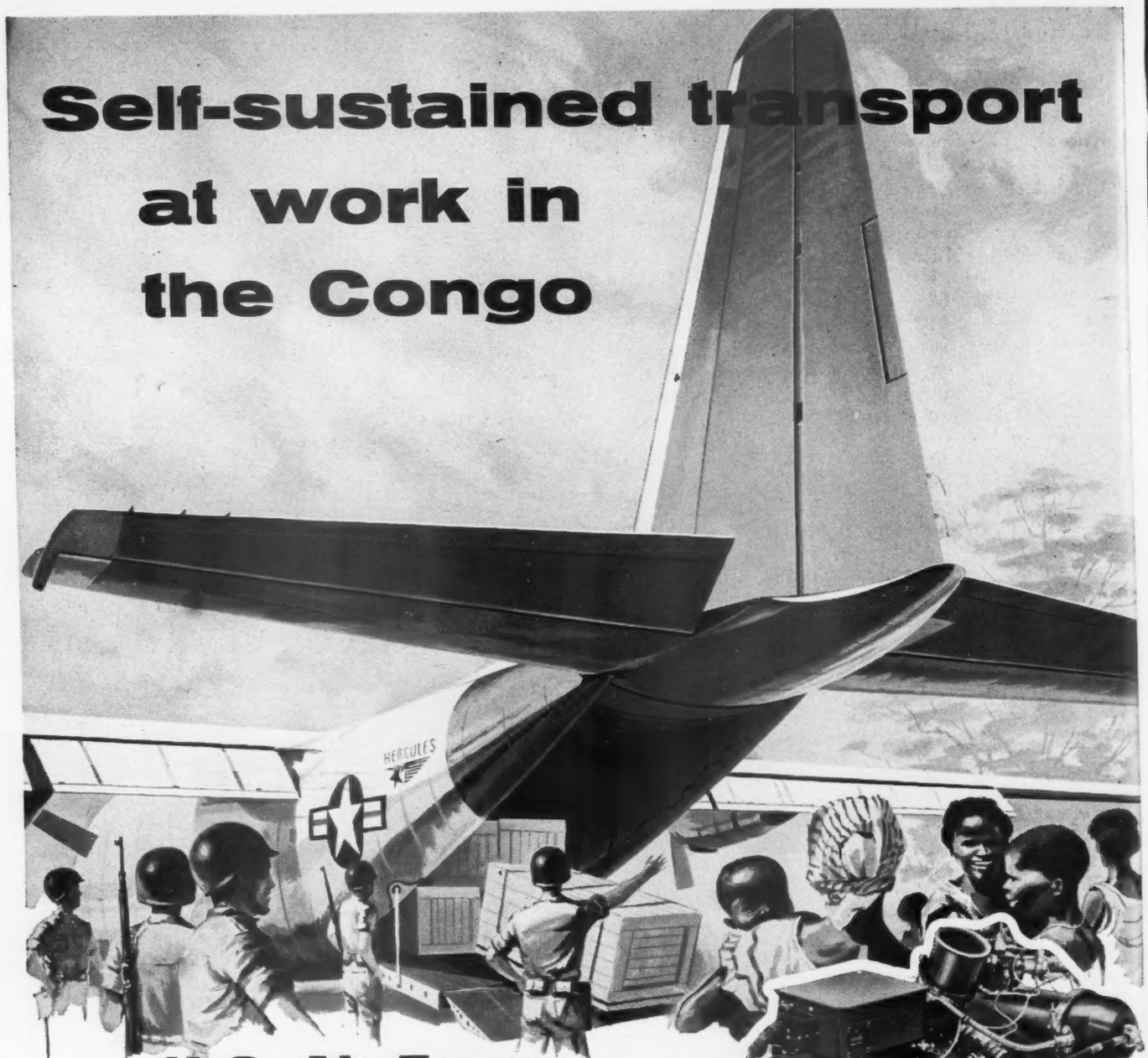
In these later years all that you are, all that you have learned and experienced, all that you have accomplished is evident.

If you are among those young Air Force officers who are thinking about an Air Force career, these years should be considered a goal. For if you are accepted for a full Air Force career, it is then that our nation will *most* depend on your leadership, your judgment... and you.

The later years are an important part of what makes the whole thing worth working for.

There's a place for tomorrow's leaders on the Aerospace Team

Self-sustained transport at work in the Congo



U. S. Air Force Lockheed C-130 Hercules

The recent crisis in the Congo has once again proved that the self-sustained aircraft is of vital importance in transporting cargo and passengers to and from landing fields where no ground support equipment exists.

The USAF Lockheed C-130 Hercules is designed to land and take off from extremely short runways carrying heavy loads of cargo or passengers. Equipped with an AiResearch gas turbine and starting system, the C-130 is entirely self-sufficient and can operate from the heat of the Congo to the cold of the Antarctic without the need of ground support equipment.

AiResearch gas turbine compressor GTC85 is built into the left wheel well of the C-130.

AiResearch air turbine starter ATS100 is installed on each of C-130's four turboprop engines.

Please direct inquiries to Phoenix Division.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

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Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

sey, swept the skies clean and pummeled aggressor ground forces, ARALAF dropped **7,000 troops and 900 tons of equipment.** That afternoon C-123s, landing on dirt strips in the drop zone, brought in **500 more troops and 400 tons of cargo.** Next day, ARALAF airdropped and airlanded another 1,000 men, while delivering or dropping **1,000 tons of equipment in resupply runs.**

The main phase of the exercise was virtually completed.

But **Lt. Gen. T. J. H. Trapnell,** Army exercise director, then called on the **82d Airborne,** based at Fort Bragg, to "reinforce" the 101st. Two battle groups of the 82d moved to dispersal bases during two days of heavy rain. On August 24 the skies cleared enough to allow the second airborne assault, and ARALAF dropped **3,700 men, together with 450 tons of equipment.**

All told, ARALAF delivered **10,419 troops and 2,845 tons of equipment** into the combat zone, while ANGTAF was flying **900 air-cover and tactical-support missions.**

Ground crews of the AFR and ANG picked up the most bouquets. They maintained an in-commission rate of **ninety-five percent on ARALAF's 500 C-119s and eighty-five percent on the Air Guard's 100 fighters and reconnaissance planes.**

Gen. Thomas D. White, USAF Chief of Staff, wired **"hearty congratulations"** to commanders of TAC, CONAC, and MATS on the performance of their active and reserve forces units.

New Guard, Reserve Planes

Fresh equipment changes are **just ahead for both the Air Force Reserve and the Air National Guard.**

The Air Guard, which has already added **C-97s, F-102s, and F-104s** to its inventory this year, is destined to continue its fast pace of conversion over the next twenty-four months. And the reserve should get its **first four-engine transports** almost immediately.

Enough **C-124s** are scheduled to "fall out" of the Air Force inventory to equip about **six Air Force Reserve squadrons** by this time next year. C-119s released by those six squadrons are to be **turned over to other reserve squadrons** to bring them up to authorized equipment levels.

The result will be a substantial **net increase** in the reserve's combat airlift capability.

Meanwhile, **the Air Guard is headed for sweeping changes** in its over-all composition. It will continue with **ninety-two flying units,** as it has now. But some **fifteen air defense squadrons and two tactical reconnaissance units** are expected to change to new missions.

Of these, nine are earmarked for **long-range transports,** four for **tankers,** and four for **aeromedical evac roles.**

Recovery and Support

CONAC began tests in connection with its new **base support and airfield recovery missions** on September 1, when it activated **six Air Force Reserve base support groups and seven Air Force Reserve recovery groups and squadrons.**

CONAC plans at present to develop a total of **fifty or more base support groups and eighty-two recovery groups.** The latter would be converted from existing Air Force Reserve training units, while base support groups would be organized at active Air Force bases using reservists living in the area.

The program is starting out on a **comparatively small scale** to develop blueprints on detailed functions, together with manning and equipment documents.

Each new CONAC region gets **one of each type of group,** except that the second region was assigned **two recovery groups.**

Base support groups are designed to augment existing air base groups on active USAF bases. The first such groups have been set up at **Westover AFB, Mass.; Wright-Patterson AFB, Ohio; Sewart AFB, Tenn.; Randolph AFB, Tex.; Richards-Gebaur AFB, Mo.; and Travis AFB, Calif.**

The primary function of recovery units is to **man civilian airfields for emergency USAF use.** Each recovery group, under present plans, might control as many as **six recovery squadrons,** or a combination of recovery squadrons and individual training units. These groups will take the place of **existing Air Reserve training centers.**

The first recovery groups, each with one recovery squadron, were activated from Air Reserve Center personnel in **Worcester, Mass.; Wyoming, Pa.; Louisville, Ky.; Columbia, S. C.; New Orleans, La.; Des Moines, Iowa; and Salt Lake City, Utah.**

Passage to India

Twenty Air Force Reserve officers and airmen of the **512th Troop Carrier Wing,** Willow Grove, Pa., took part in one of the **longest ferry missions** on record this past summer. The men—fifteen from squadrons at Willow Grove and five from the Wing's detached squadron at Niagara Falls, N.Y.—made up four aircrews in a **USAF mission to ferry twenty-one C-119 Flying Boxcars to India** for turnover to the Indian Air Force.

The four planes took off from **Langley AFB, Va.,** on July 1 as part of a flight of eleven aircraft. They flew then to **Newfoundland, the Azores, France, Greece, Cyprus, and Saudi Arabia** en route to **Agra, India.** The reserves received personal congratulations from **Gen. Curtis E. LeMay,** USAF Vice Chief of Staff, on their return to the US via MATS.

Besides the 512th, troop carrier wings that were involved in the project were the **94th,** from Laurence G. Hanscom Field, Mass.; the **403d,** Selfridge AFB, Mich.; the **434th,** from Bakalar AFB, Ind.; the **435th,** from Miami, Fla.; the **440th,** from General Mitchell Field, Wis.; and the **442d,** from Richards-Gebaur AFB, Mo.

Live Competition

Realistic combat conditions will characterize CONAC's **fourth annual troop carrier tournament** at Fort Campbell, Ky., October 19-22. **All fifteen troop carrier wings,** plus elements of **Tactical Air Command,** will participate. For the first time, competing crews will **drop airborne troops and their equipment** instead of the usual dummies and bundles.

Teams will be rated **on crew coordination and discipline, formation techniques, rendezvous precision, low-level, medium-level, and celestial navigation, and flying safety.**

The Lady Major

Maj. Marge Gray, USAFRes, recently became the **first woman to complete the two-week defense strategy seminar for reservists at the War College, Maxwell AFB, Ala.** Major Gray, one of the first women to be commissioned in the wartime WAF, has more than 2,000 hours in all types of planes. She has a mobilization assignment at EASTAF, McGuire AFB, N. J., and until recently was a member of the editorial of *Flying* magazine.—END

READING AN INFERNO'S SECRETS...
Missile "silo" concept proved practical by Lockheed Electronics

The U.S. Air Force came to Lockheed Electronics with an extremely complex and urgent problem. Could the tremendous shock and heat of a missile blast-off be accurately measured in launchings from an underground silo?

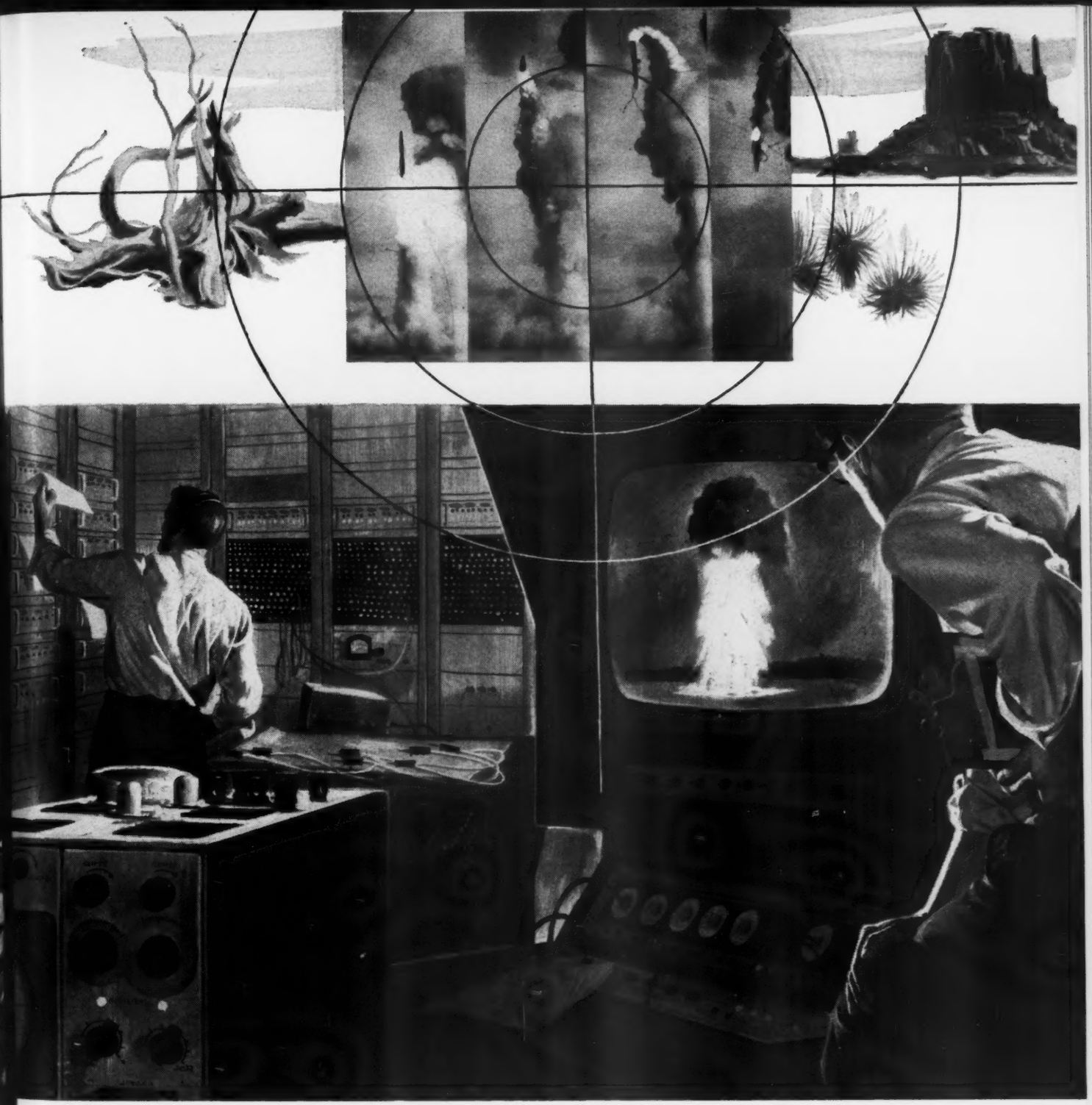
Lockheed Electronics designed and built a special data-gathering system to analyze, through instrumentation, the searing heat and violent shock of more than 40 test firings. During each test more than 200 measurements were made simultaneously.

Results have produced new understanding of missile stresses, acoustics, thermal radiation, shock and vibration. This vital information is already being applied to the design of "hard" launching sites.

The capabilities of Lockheed Electronics, Information Technology Division extend to all phases of data handling—a fact well worth remembering when you encounter tough problems in this field.

CAPABILITIES—INFORMATION TECHNOLOGY DIVISION

Data processing
Data storage • Telemetry systems
Data reduction and display
Special-purpose computers
Traffic control systems • Systems research



MINDING THE FUTURE

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Research and development —the term means different things to different people. But the immense importance of technical progress to our national well-being makes it imperative that we ask . . .

WHAT DO WE MEAN BY RESEARCH AND DEVELOPMENT?

David Novick

WE ARE trying to build tomorrow's systems with today's methods and yesterday's knowledge." These were the words of Lt. Gen. C. S. Irvine, USAF (Ret.), speaking in New York on June 24, 1959, some time after the dawn of the space age.

He added: "Production techniques hailed as breakthroughs are for the most part merely present applications of known principles." In support of his position, General Irvine, then Deputy Chief of the Air Staff (Materiel), cited the use of the forty-year-old gyro for inertial guidance, extension of principles of radar known for more than twenty years, and Dr. Robert Goddard's work with rockets more than thirty years ago.

General Irvine's statement indicates that much of our current research and development is based on knowledge many years old. It raises the question, also, of how much that is new and really different can be expected from a Defense Department research and development budget estimated at $3.7 billion for fiscal 1960 or a 1960 industrial R&D budget estimated at more than $7 billion.

Just how are the dollars being spent? Are we really using more dollars to acquire new knowledge on which future weapons and equipment depend? Or, are we merely reclassifying traditional outlays into the newly fashionable research and development categories?

In trying to provide answers to these and related questions, it quickly becomes apparent that the present use of the term "research and development" both at the national level and in company accounting practice is confused and confusing, if not misleading.

Basically, the trouble starts with the words "research and development," which mean radically different things to the scientist, the engineer, the marketing expert, the historian, and even the school boy.

One definition, from the *Dictionary of Contemporary Usage* by Bergen and Cornelia Evans, makes this clear:

> *Research* has become very popular in the United States since the outbreak of World War II. As Henry D. Smyth has observed, the idea that the object of research is new knowledge does not seem to be widely understood and "a school boy looking up a word in the dictionary is now said to be doing research." Indeed it has been debased even further. Research is frequently used to describe reading by those to whom reading, apparently, is a recherché activity and for many a graduate student it is a euphemism for wholesale plagiarism. The word needs a rest or at least less promiscuous handling.

Since no one can quite agree on the meaning of "research" or "development," it would be indeed surprising if common accounting practices were followed to identify dollars spent for the expansion of science, engineering, and technology. As a result, there is no way of determining whether the $10 billion R&D expenditure figure for 1959, commonly used, is really a significant measure of the current national effort.

Our present outlays for R&D have been described as being sixty times greater than in 1929 when outlays were estimated at $166 million. Today, according to Defense Department reports, research and development contracts awarded to ten major military equipment manufacturers account for a minimum of ten percent and a maximum of fifty-seven percent of military sales *(see table on following page)*.

But what is the real significance of these figures? We know that recent changes have been made in the Defense Department classification of R&D, with the result that this budget category now includes money not previously labeled "research and development." Actually, the process has been described as one of

(Continued on page 117)

He juggled the hottest potatoes in the Seawolf

...the fuel elements for its nuclear power plant.

Periodically, spent elements must be removed and replaced with fresh ones. The problem—utterly original and fiendishly difficult—was to do the job safely, quickly, and, above all, surely.

This AMF engineer designed the refueling system that did the job. One of his major problems was the fuel elements' liquid sodium environment. Sodium burns fiercely when brought in contact with either air or water. Yet, it had to be exposed during element transfer. Solution: an inert helium blanket to isolate the sodium.

Though awesomely intricate, the refueling machinery had to be designed to work in cramped quarters. The high radioactivity of the environment made the handling problem still more difficult.

That's why, though remotely controlled, all apparatus is *manually* operated. It removes the element and transfers it to a disposal container with complete safety, accuracy, and a degree of reliability that approaches the supernatural.

Single Command Concept

The solution of this first-time-in-history problem is one more example of AMF's resourcefulness.

AMF people are organized in a *single operational unit* offering a wide range of engineering and production capability. Its purpose: to accept assignments at any stage from concept through development, production, and service training... and to complete them faster...in

- *Ground Support Equipment*
- *Weapon Systems*
- *Undersea Warfare*
- *Radar*
- *Automatic Handling & Processing*
- *Range Instrumentation*
- *Space Environment Equipment*
- *Nuclear Research & Development*

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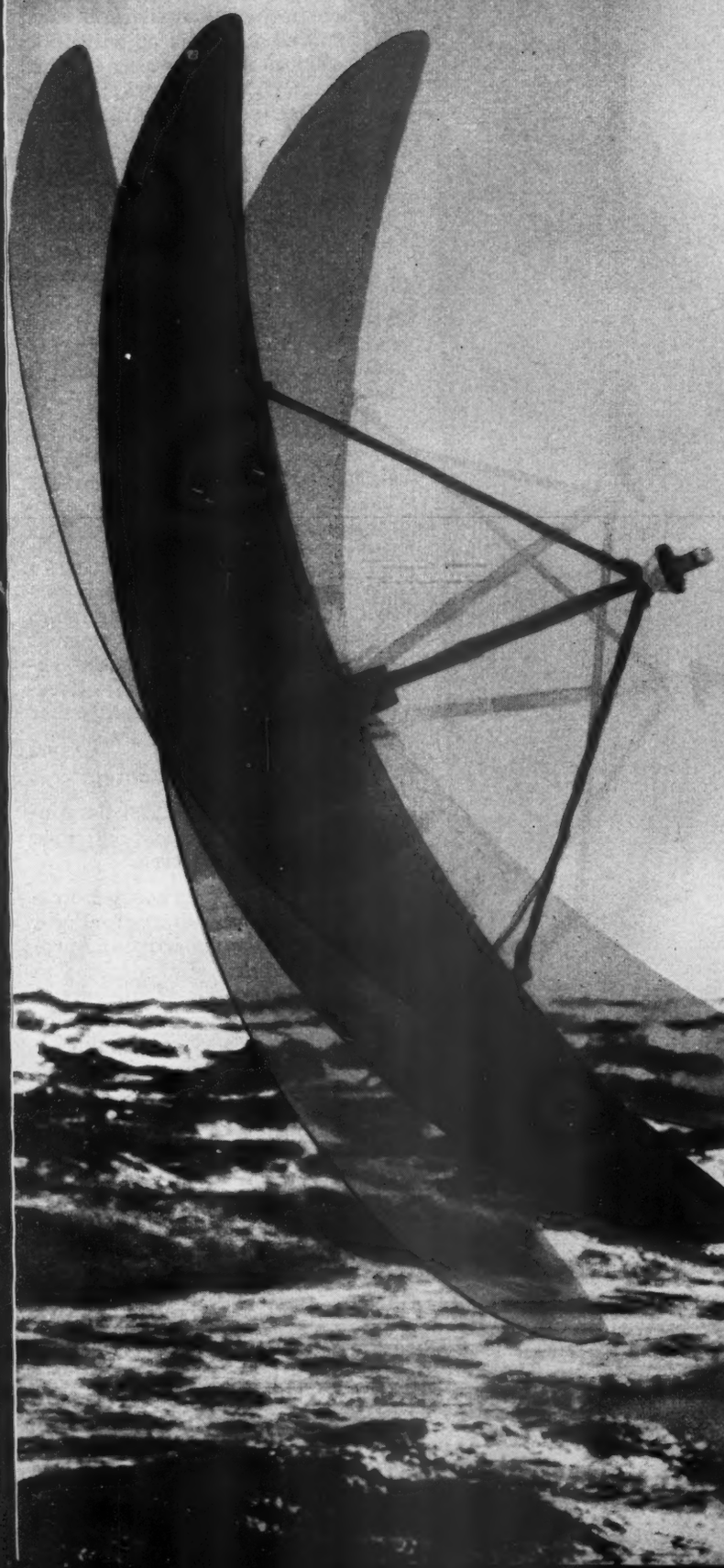
What's up...and where?



Philco airborne radar for ALRI extends the vision of SAGE

ALRI, the Airborne Long Range Input system of the U. S. Air Force, is the seaward extension of SAGE, the vast electronic network that warns of aircraft approaching the North American continent. Philco will develop, produce and modify the airborne height-finding radar as an ALRI team member under the system manager, Burroughs Corporation. Philco was selected for this vital work because of its long and extensive experience in the development and production of military airborne radar and its major contributions to radar technology. Here is further evidence of Philco's leadership in advanced electronics . . . for reconnaissance, communications, weapon systems, space exploration and data processing.

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R&D COMPARED WITH TOTAL SALES*

Contractor	FY 1959 Sales in Millions of Dollars	R&D in Millions of Dollars	% R&D to Sales
General Dynamics Corp.	$1,616,400	$313,061	19.3
Boeing Airplane Co.	1,166,500	155,781	13.3
North American Aviation, Inc.	1,018,100	567,744	55.7
General Electric Co.	914,000	395,057	43.2
Lockheed Aircraft Corp.	898,500	511,430	56.9
Douglas Aircraft Co.	676,400	208,266	30.7
United Aircraft Corp.	538,200	78,651	14.6
Martin Co.	524,000	284,039	54.2
Hughes Aircraft Co.	494,000	49,480	10.0
Western Electric Co., Inc.	462,500	226,037	48.8

*DoD Reports, "500 Contractors Listed According to Net Value of Military Prime Contract Awards for Experimental, Developmental, Test and Research Work," and "100 Companies and 129 Subsidiary Corporations Listed According to Net Value of Military Prime Contract Awards," both for fiscal year 1959.

taking funds out of the procurement and production or operation and maintenance pockets and transferring them to the R&D account.

As far as industry is concerned we know that some consideration has to be given to the effect of the Internal Revenue Act of 1954, which permitted corporations to "expense" R&D outlays.

A revealing statement was made by Dr. J. A. Hutcheson, Vice President, Westinghouse Electric Corporation, in announcing his company's $185 million 1959 budget for R&D. He pointed out that to measure research spending as a percentage of sales is meaningless unless the objectives are defined and the figures broken down. He defined his company's proposed research program: 1.9 percent or $3.5 million for "Blue Sky" research not connected in any way with current products but promising for the long-range future; 3.2 percent or $6 million for long-range major development programs aimed at identifying the characteristics of products which the company may make five or ten years in the future; 6.4 percent or $12 million for searching out new knowledge known to be needed as a result of earlier research; 9.6 percent or $30 million for standard product development to modernize and improve existing products; and 78.9 percent or $133.5 million for the development to customer order of customer-tailored equipment.

Clearly, the Westinghouse program can be broken down into several different categories to yield different amounts of effort in advanced or long-range research and development as compared with short-range research and product improvement and application.

The great reported expansion of R&D cannot, of course, be all attributed to statistical delusion. However, there is grave doubt as to whether any of the statistics are very meaningful. There is even graver doubt as to what available data really means in terms of an expansion of research effort that promises the Brave New World of manned spaceflight and eighty-minute trips around the earth. It is evident that, even if the data were comparable, adjustments would have to be made for price changes. Using three adjustment factors—engineers' salaries, producers' durable goods, and the Gross National Product—to eliminate inflation, it becomes apparent that the reported sixtyfold increase in research and development ought to be cut to a twenty-five- or thirtyfold increase in terms of real dollars.

Another way of measuring the increase is by counting the number of scientists and engineers engaged in research in 1941 and again in 1952. This measure does not take into account price changes or variations in accounting practice. Using this measuring device, in the period from 1941 to 1952, the number of research engineers and scientists doubled—much slower rate of growth than the adjusted dollar outlays would indicate.

However, without a common classification by which current activities and their promise for the future can be measured, we cannot determine what we are really doing and whether our effort is sufficient.

Recognition of this need is implicit in recent testimony of Dr. Joseph Charyk, Under Secretary of the Air Force. Testifying before the House Appropriations Committee in support of the fiscal 1961 budget, Dr. Charyk said:

> Basically, the research and development effort itself can be categorized in four parts: namely, basic research, applied research, advanced development, and weapon system development. Public visibility is focused on the latter area and our military strength in the immediate future rests, of course, on such weapon system development. However, our long-range military posture and national strength rests on the adequacy and vigor of the first area. Unfortunately, there is considerable public apathy and a lack of under-

(Continued on following page)

RESEARCH AND DEVELOPMENT:
STEPS, ACTIVITIES, AND PROMISES FOR THE FUTURE

Step	Activity	Promise
I	Basic Research Experimental Research Basic Development Advanced Research	Understanding of universe and organization of knowledge about it to: a. Permit major changes in ways of looking at phenomena and activities; b. Create new devices and methods for accomplishing objectives; and c. Identify phenomena and activities which permit revolutionary changes in existing products, methods, and approaches. Its promise is great but not identified to specific purposes, and the possibility of fulfillment is *highly uncertain.*
II	Applied Research Advanced Development Basic Evaluation Basic Testing	Singling out or identifying specific potentials or applications with a view to developing devices or methods for utilizing the new general knowledge obtained in Step I. Application or usefulness is identified but the economy, efficiency, and acceptability of the proposals remain uncertain. Promise is for great new things.
III	Product Development Product Testing Product Evaluation Pilot Production	Specific devices or methods appear as likely solutions but must be brought reasonably close to final application to determine effectiveness, economy, and acceptability. Do-ability has been established and major advances are promised.
IV	Product Application Application Research Applied Testing Application Evaluation	New uses and applications or modifications of existing uses or applications are sought for existing methods, products, or components: may result in substantial benefits to users or producers. Some success is reasonably assured since it is evolutionary rather than revolutionary.

standing in regard to this area. One of our most important responsibilities in the management of research and development, therefore, is the determination of the proper balance between these areas and the insurance that the program scope and content is adequate within each area. On the one hand, we must ensure that continued adequacy of our military strength in the year immediately following, but in so doing it is essential that we do not neglect those items that could make the difference insofar as national survival is concerned in the longer-range future. The foundation of our technical progress rests on the vigor of our basic scientific programs and their nature is such that if these are neglected no amount of dollars in later years can adequately eliminate the deficiencies that can be created.

In an attempt to measure each step of the research and development effort and to identify the promise for the future that each holds, the table on page 117 is offered.

Earlier the question was raised of how much of our R&D dollars was used in new basic research as compared with other types of research and development effort. Using the classification suggested here, it would appear that about seventy percent of the research and development effort is in Step IV, twenty-six percent in Step III, three percent in Step II, and about one percent in Step I.

Although available information does not permit quantitative analysis in specific terms, my guess is that the $10 billion for R&D in fiscal 1959 was probably distributed as follows:

Step	*Promise*	*Dollar Distribution*
I	Brave New World	$ 100,000,000
II	Possible use of new discovery	300,000,000
III	Application of new knowledge	2,600,000,000
IV	Improved application of existing knowledge	7,000,000,000

One reason why Step I, or Brave New World, outlay is small is that this type of activity is normally low in its resource demand. Only occasionally, as in the newly approved Project "M" linear accelerator at Stanford, do expenditures reach the multimillion-dollar level. For the most part, this type of research involves one or at the most a few individuals. The equipment is paper and pencil, blackboard and chalk, and relatively small laboratories. It is only when use or application is involved that expenditures jump sharply.

Probably most important in establishing the low level of Step I activity is the US interest in application or experimentation rather than in basic science. Much of our basic science has been imported, chiefly from Europe. The bulge in our scientific discoveries in the last twenty-five years is probably more the result of European scientists coming to this country as refugees from fascism, communism, and nazism than any real expansion in our own indigenous capability. Einstein, von Neumann, and Teller are a few of the scientists whose US contributions are transplants from Europe. There is no assurance that we have yet developed a needed congenial "climate" for basic research in this country.

Still another reason for the low Step I expenditures is that only a small number of people are capable of or interested in this kind of activity. Recently, there has been a marked increase in emphasis on education in mathematics, engineering, and science, and larger numbers of students are being encouraged to study these subjects. However, there is serious question that increasing the numbers of trained scientists and engineers will by itself produce more basic science. Other conditions may be needed to provide a favorable climate for great ideas.

Step II expenditures can be estimated at about three times those of Step I. However, the amount is still small for the same reasons that apply to Step I. Expenditures are starting to climb because more people are available for and capable of doing this type of work and more elaborate equipment and methods can be used. Illustrative of this is the 1940 estimate that $100,000 would be required to attempt the first nuclear chain reaction. Very little had been spent in the basic projections. Billions were required for Step III in the development of nuclear fission.

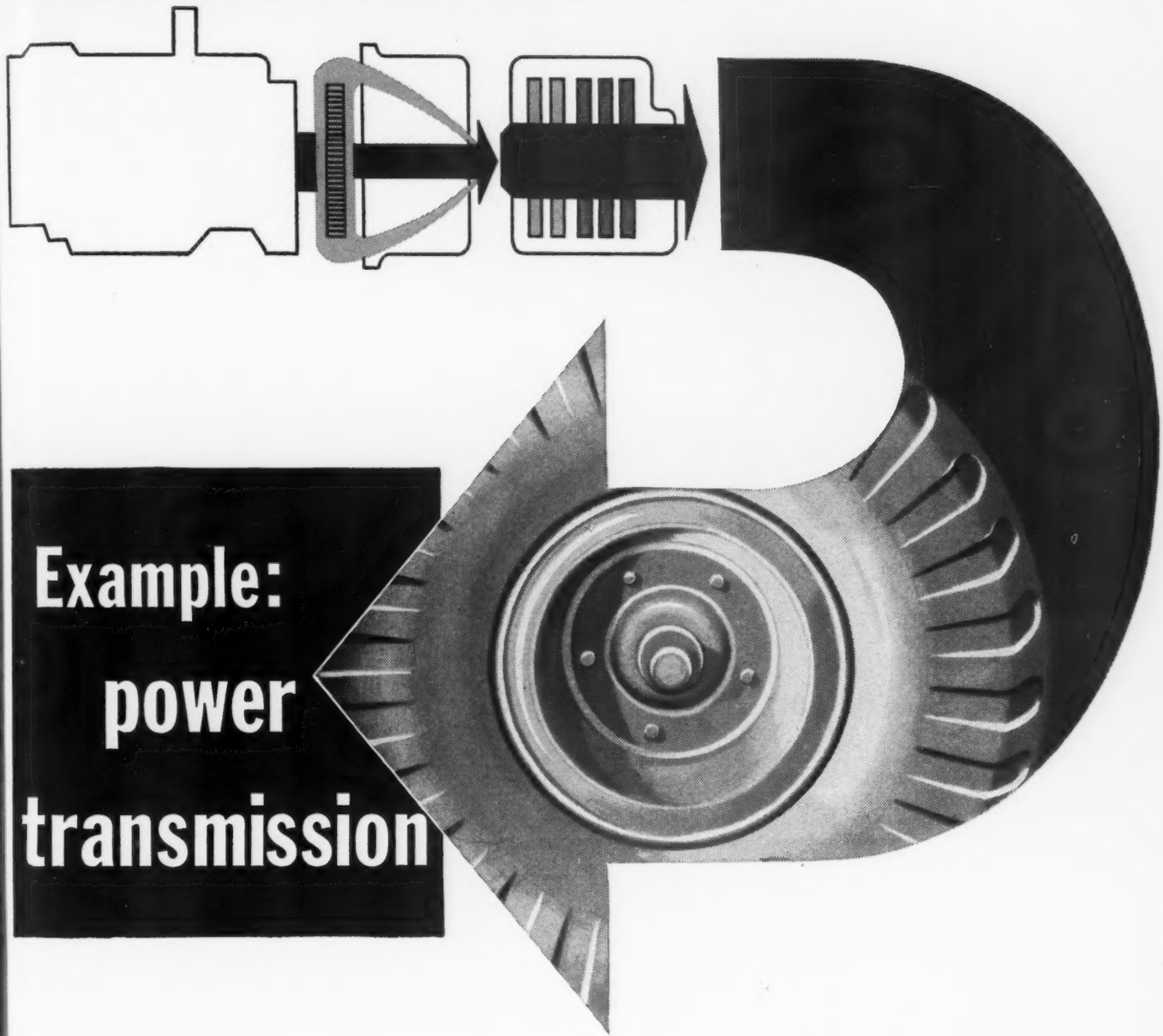
The wide spread of expenditures between Steps II and III in the development of atomic energy is typical of military programs. In many modern weapon developments, the size of the resource demands in Step III becomes spectacular because of the pressure of time. The need to shorten the development cycle has led in some cases to a concept of concurrency in which pilot production and research go forward together—a most expensive procedure. In other cases where time is not so important Step III expenditures are smaller. Product development and buildup are more gradual. With a more leisurely approach, many of the problems in a given development program are solved as a part of an independent research effort.

Most expenditures occur in Step IV. There is now a reasonable assurance of success. Changes sought are, for the most part, small order variations in proven methods and devices. Very large numbers of people are available for and are interested in the effort. Changes of this kind are the essence of day-to-day business and professional activity. The work, to quote Dr. Charyk again, has "public visibility" and, in the case of the military, national security in the immediate future rests on such weapon system development. These are, of course, good reasons for the Step IV activity. However, unless a proper climate is created and adequate funds provided for Steps I and II, it may well be that we will be forced to continue to build "tomorrow's systems with today's methods and yesterday's knowledge."

Without an adequate classification system of the type here outlined, it will be virtually impossible to determine how and where effort must be applied so that technical progress can be assured.—END

The author, David Novick, is head of the Cost Analysis Department of the RAND Corporation. During World War II he was Controller of the War Production Board, Director of the Board's Program and Statistics Bureau, and, later, Director of the Board's Demobilization Bureau. He was among the principal architects of the government's wartime material allocations plan, and has since been an adviser to several federal agencies in economic planning for defense.

Caterpillar Capability for Defense...



Example: power transmission

NEEDED: quick-shift transmission for various heavy vehicles . . . instant change of speed or direction under full load . . . resistant to shock . . . smooth, reliable performance. **RESEARCHED:** Transmission and gear design involving new techniques in metallurgy and hydraulics—developed after 50,000 field test hours of prototype designs under instrumented control. **PRODUCED:** Power Shift Transmission . . . combines direct and torque converter drive . . . split-second, finger-tip shifting . . . all condition, dependable performance.

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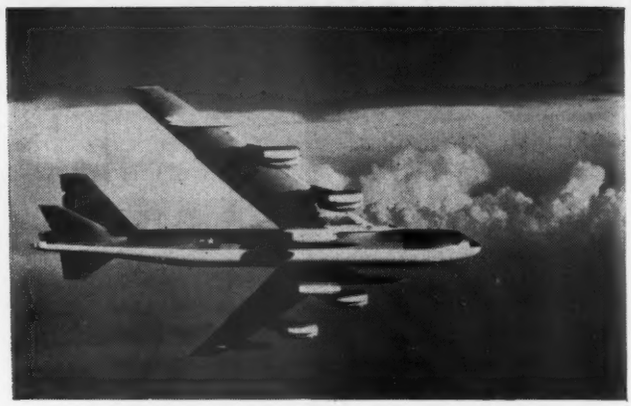
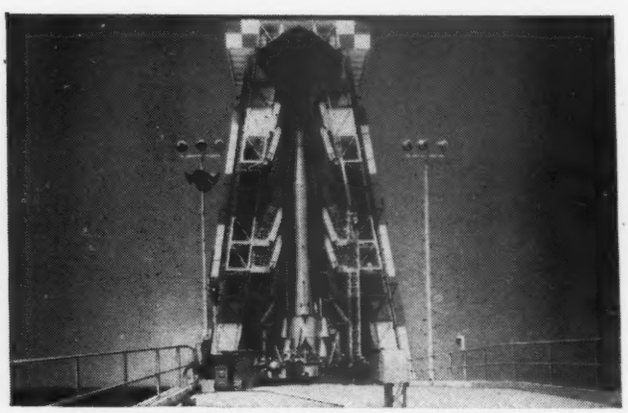


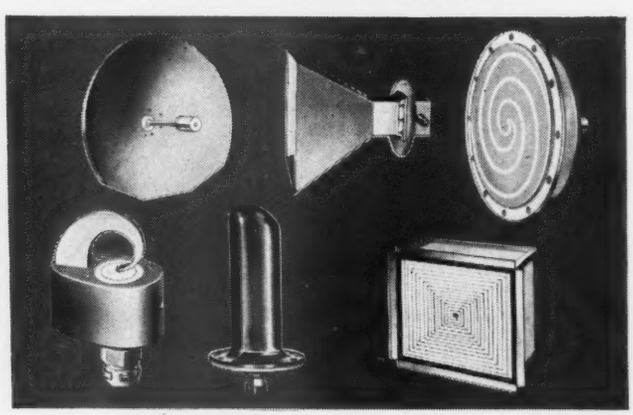
B-52 and other military aircraft will be protected by the most potent Electronic Countermeasures equipments yet devised. These equipments were developed in close teamwork with the Air Force under Hallicrafters' QRC (Quick Reaction Capability) program. Now qualified to meet full environmental specifications, they are in quantity production.

New levels of speed and efficiency are being reached in equipment modernization, retrofit and technical support programs with Hallicrafters' radical new "Blue Streak" project. Specially-trained Maintenance and Technical Support Teams, close-knit and flexible, can be tactically deployed to accomplish maintenance, installation and testing of electronics weapons systems anywhere in the world.

Hallicrafters communications leadership is exemplified by new high frequency Single Sideband receiver, (model no. SX-116). 100% modular design permits simple modification for compatability with existing and future communications systems. Stability, with proper available plug-ins, is better than one part in 10,000,000 per month. Hallicrafters also offers an existing capability in receiving and transmitting techniques up to frequencies of 50,000 megacycles.



Hallicrafters participation in the Atlas missile project helped to develop capability for many areas of the complex missile field, including code translator data systems; ground support equipment; ECM testing and antenna systems. Current explorations involve latest Infra Red techniques.



Airborne antennas and micro-wave components with power capability in excess of 1,000 watts, can be made available to solve tomorrow's very high power handling requirements. Testing of microwave components is possible with special high power generators, designed and built by Hallicrafters.

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AFA NEWS

SQUADRON OF THE MONTH

San Francisco, Calif., Squadron, Cited for

demonstrating dedication to the mission of the Air Force Association through outstanding effort that made the 1960 National Convention and Aerospace Panorama successful.

President Howard T. Markey, who has logged many miles for AFA in the past year as the Association's top missionary, put another fast trip under his belt on July 25 when he dropped in on the **Mobile, Ala., Squadron** for an address at Brookley. He spoke to a packed house at the Officers Club, the audience including members of the Squadron as well as guests of the club and their wives.

John Comish, Mobile Squadron Commander, was on hand to greet Mr. Markey as he landed and introduced him to the gathering at the dinner. **Will O. Ross,** South Central Regional Vice President, was among honored guests also introduced.

Fresno, Calif., Squadron's latest effort in its education program was a conducted tour of United Air Lines facilities for students and adult guests. The Squadron's **Sam Boghosian** was in charge of the program. It included inspection of flight simulators, hangars, flight lines, and a United aircraft.

The Squadron also has contributed a library of novels to the patients at the **VA Hospital in Fresno.**

John Herrick *(see cut)* of Space Technology Laboratories, Inglewood, Calif., was a recent guest speaker before the **Santa Monica Squadron** in the Miramar Hotel. His presentation covered STL efforts with specific reference to the space exploration work it is doing.

Mr. and Mrs. George Brubaker of Brentwood, Calif., also attended the special meeting, and presented a lecture illustrated with slides on a recent trip through Russia.

In charge of the program was **Lee Duston,** Squadron Commander. Early in August, soon after the meeting, the Squadron, as well as his many other friends in AFA, were saddened at Duston's sudden death. We know we speak for everyone in AFA in expressing our sorrow.

This news item will have to come under the heading of "better late than never." It came to us too late for the last issue. The **First Reserve Squadron of Long Beach, Calif.,** sponsored a panel discussion on the role of the reserves in the armed forces, featuring **Col. Guy Harvey,** USAFR; **Col. Jim McNamara,** USAR; and **Lt. Cmdr. William Ripley,** USNR. The program took place June 23 at Long Beach Municipal Airport.

John I. Bainer, Commander of the Squadron, arranged the program, and served as moderator. He also presented the Squadron's citation for outstanding service to **Lt. Col. George F. Schlagel,** former Commander of the 452d Troop Carrier Wing and a strong supporter of the Squadron's programs.

At the annual meeting of the **Idaho Wing, Clarence E. Hall** of Boise was elected Commander to succeed **Dale J. Hendry.** Hall is a pilot with West Coast Airlines. The meeting, which included a reception and banquet, was held July 16 at the Turf Club in **Twin Falls,** home of the newest AFA Squadron in Idaho. **Warren B. Murphy,** Squadron Commander, also served as chairman of the arrangements for the event.

Reporting to the delegates were **Hendry,** speaking on the activities of the Wing during 1959-60; **James M. Trail,** former Chairman of the Board of Directors of AFA; and **Gus Duda,** AFA Organization Director. Other officers elected to serve with Hall were **William L. Claiborn,** Kimberly, Vice Commander, and **George A. Post,** Boise, Secretary-Treasurer. The Wing now consists of three Squadrons.

Morris Ribbler, Dayton, a former Commander of the **Wright Memorial AFA Squadron** there, was elected Commander of the **Ohio Wing** at its 1960 convention, held in Cincinnati on July 10. Ribbler is Logistics Support Officer at Dayton Air Force Depot. Other officers elected were **Don Wohlford,** Vice Commander; **Charles H. Goerth,** Secretary; **Robert I. Erman,** Treasurer; and **Glenn D. Mishler,** Organization Director.

Feature event on the program was the annual awards banquet, at which **Willard L. Dougherty,** Great Lakes Regional Vice President, was presented a special "Wing Man of the Year" award, the first time the award

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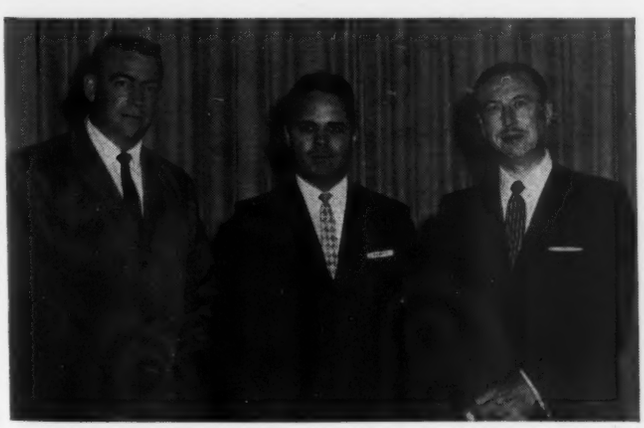
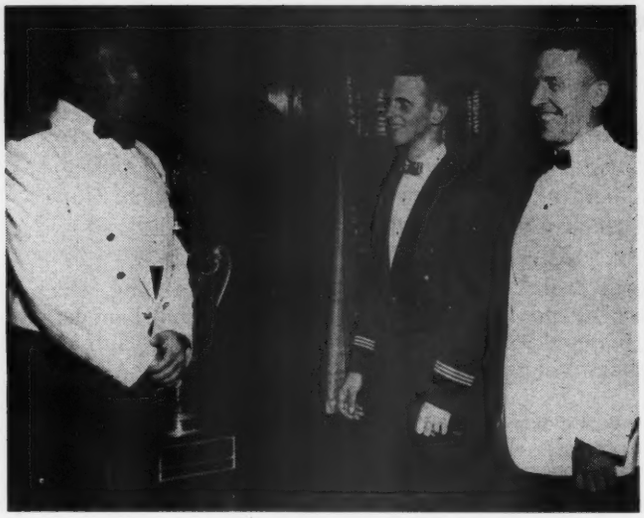


President Howard Markey is flanked by Jack Comish, left, and Will Ross during recent Mobile AFA meeting held at Brookley AFB. Comish is Mobile Squadron Commander and Ross is South Central Regional Vice President *(see text)*.

Santa Monica Squadron meeting featured address by John Herrick, third from left *(see text)*. Others above are the late Lee Duston, Commander, Wilma Plunkett, Secretary, and Ron McDonald, the Los Angeles Group Commander.



Maj. Gen. Arno H. Luehman, USAF Director of Information, Cadet Richard J. Hillman, 7th Squadron Commander, and Don Olson, chairman of the program, are shown at AFA banquet honoring USAF Academy Honor Squadron of 1960.

Obviously proud, and deservedly so, Cadet Hillman and Maj. Earle Ambrose, 7th Squadron Air Officer Commanding, admire AFA Trophy. Cadet Hillman since has received his commission. He has now reported to active duty with USAF.

has been presented. **Miss DelVina Wheeldon** received the Wing Aerospace Award for her efforts to create better public understanding of the USAF mission through the medium of radio and newspapers.

Brig. Gen. Henry G. Thorne, Jr., Commander, 3500th USAF Recruiting Wing, was the guest speaker. Guests included **Maj. Gen. Alfred Johnson,** USAF (Ret.), **Col. Barney Oldfield,** NORAD Director of Information, and **Col. Henry B. Wilson, Cmdr.,** 3502d USAF Recruiting Group.

Pittsburgh Squadron has accomplished another successful community education program. The latest function featured presentations by representatives of the Army, Navy, Marine Corps, Air National Guard, and Air Force at a meeting in the Penn-Sheraton Hotel.

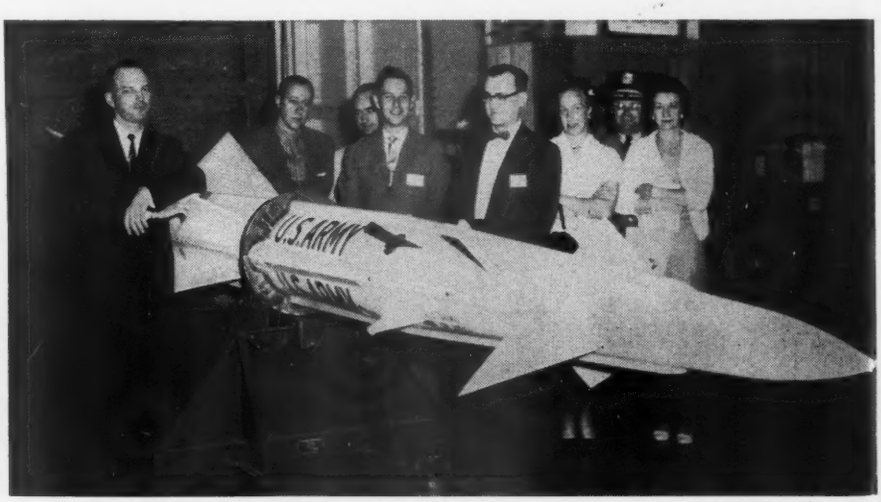
Lt. Tom Cindric, USAF, Past National Commander of the **Arnold Air Society,** served as moderator for the program, which attracted a large turnout of AFA members and guests. Panel members were **Capt. Louis D. Kish,** USA; **Maj. Paul Shernisky,** USAF; **Col. Michael C. McCarthy,** ANG; **Lt. Cmdr. Dan R. Klinger,** USN; and **Capt. Frank H. Wright,** USMC.

Carl Long, Chairman of AAF's Organizational Advisory Council, and **Mrs. Ruth E. Young,** a Squadron programing spark plug, were in charge.

On the subject of aerospace education, the **Utah Wing** sponsored the attendance of four **state educators** at the National Convention in San Francisco. The Wing, outstanding for several years in the area of education, thus made another notable contribution.

—Gus Duda

During Cleveland Squadron-Kiwanis Kids Day program, five area USAF Academy Cadets home on leave are shown helping to admire AFA Man of the Year Trophy presented to Cleveland's Will Dougherty, second from right, at Miami in 1959.



Members of Milwaukee's Billy Mitchell Squadron recently were briefed on the activities of a US Army Nike battery. Some of them are shown here with one of the birds. Bob Gerlach, Wing Commander, is shown leaning on the missile.

THE PROBLEM SOLVERS

NERV POWER

AEROLAB ROCKETS HELP PROBE VAN ALLEN BELT

Better, safer design of manned space vehicles is expected from a closer study of the Van Allen radiation belt to be made by Project NERV (Nuclear Emulsion Radiation Vehicle) in which NASA has awarded Aerolab a prime contract.

ARGO D-8 rockets, developed by Aerolab, will boost 125-lb. instrumentation payloads, in the nose cones, to 1500-mile altitudes and 1700 miles down the Pacific Missile Range, to measure nuclear bombardment above the atmosphere. Prompt recovery of the nose cones from the ocean by Navy ships demands exacting computation by Aerolab engineers to precisely plot the ballistic trajectory and impact point of the payloads.

This is typical of Aerolab's capability in arranging solid fuel rockets in combinations to provide low-cost, high-performance space probes for the acquisition of vital scientific data.

A pioneer in aerophysics research since 1946, Aerolab's capabilities now complement those of Ryan Aeronautical Company for solving design, development and fabrication problems in such advanced areas of space as: electronic navigation, automatic guidance, recovery systems, missile design, reaction controls, propulsion systems, solid state devices, and instrumentation packages.

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Your Age	Amount of Insurance On Flying Status	Not on Flying Status
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30-34	12,500	20,000
35-39	13,000	20,000
40-44	13,500	17,500
45-49	12,500	13,500
50-54	10,000	10,000
55-59	10,000	10,000
60-64*	7,500*	7,500*

*Continuing benefits. Policy must be purchased prior to Age 60.

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Application must be accompanied by check or money order.

Send remittance to: INSURANCE DIVISION, AFA, MILLS BLDG., WASHINGTON 6, D.C.

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☐ *Monthly allotment (I enclose $30 to cover the period necessary for my allotment to be processed.)*

☐ *Quarterly (I enclose $30)*

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☐ *Annually (I enclose $120)*

Please circle one:
I (am) (am not) currently on flying status.

This insurance is available only to AFA members.
☐ *I am an AFA member.*

☐ *I am an AFA member.* ☐ *I enclose $6 for annual AFA membership dues.*

AFA LIFE INSURANCE

By Richmond M. Keeney

DIRECTOR OF AFA INSURANCE PROGRAMS

Since its inception in 1946, the Air Force Association has continuously felt that broad benefits should be made available to members, provided of course that the benefits are in support of, and further the aims and objectives of the Air Force Association. The general field of insurance is particularly well suited as a membership benefit for it offers an opportunity not only to provide low-cost coverage but also to provide specialized forms of insurance which could not otherwise be made available on an individual basis.

In developing our insurance programs we have recognized that there are hazards which are unique to service personnel, particularly to those personnel engaged in military aviation. As a consequence, AFA has carefully searched out special means of protecting against these unique hazards. Flight Pay Protection pioneered coverage against loss of "hazardous-duty" pay, and Travel-Accident insurance was the first policy of its kind to offer full-time travel protection in military aircraft.

Now AFA offers a new Life Insurance Program with an extraordinary extra benefit that provides special, additional coverage for accidental death, including deaths resulting from aviation accidents. The introduction of this new insurance benefit represents one more step in a planned series of insurance programs that have been carefully designed by AFA to meet the particular requirements of service families. And, because of its special accidental death coverage, it follows Flight Pay Protection and Travel-Accident Insurance as another AFA "first" for service personnel.

Even without the extra benefit for accidental death this new coverage represents extremely broad protection, and yet one that is magnificently simple to operate. The cost remains constant and does not vary with age or with flying status; only the amount of insurance varies. This means, of course, that no red tape whatsoever is involved if and when either of these categories change. Because of this arrangement, there is never any question as to the amount of insurance owned, for it is always determined by the current flying status and nearest age of the insured.

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Birth of the Bomb

***No High Ground*, by Fletcher Knebel and Charles W. Bailey, II (Harper & Brothers, 1960, 272 pp., $4)**

Reviewed by Dr. Lee Bowen

No High Ground gives the American public its first over-all view of the atomic energy program from the time of its inception in 1939 through the destruction of Hiroshima and Nagasaki.

The authors, imbued with the dramatic significance of their subject, treat in detail the high-level decision to drop the bombs, the organization and training of a special Army Air Forces unit to conduct the combat missions, and the strike operations against the doomed cities.

The heart of the book concerns the controversial decision to use the bombs. The authors have recorded at length the arguments raised for and against employment of the weapons. However, apparently for the sake of objectivity, they made no attempt to discipline the material, which as a result is loosely organized. The collection of humanitarian objections, by sheer weight of repetition rather than logic, gives the impression that the United States was wrong to drop the bombs.

There are, in fact, two ways to look upon the bombs. Either humanitarianism, to the exclusion of all other considerations, should have ruled out their use, or else they should have been used, as they were, to strengthen the Allied military position and reduce the number of Allied casualties.

The men who were responsible for the conduct of the war—the President, the Secretary of State, the Secretary of War, and the Joint Chiefs of Staff—saw the problem realistically. The issue, they decided, was not that of killing 100,000 people with one bomb as against killing them with 500 conventional bombs. That would have been mere quibbling. The issue was how to terminate the war at the earliest date with the least number of casualties.

Winston Churchill, in his *Triumph and Tragedy*, summarized the realistic approach in a passage not quoted by Knebel and Bailey. The former Prime Minister describes his reaction to the news that the Alamogordo test shot of July 16, 1945, had been successful: "Up to this moment we had shaped our ideas toward an assault upon the homeland of Japan by terrific air bombing and by the invasion of very large armies. . . . [This campaign] might well require the loss of a million American lives and half that number of British. Now all this nightmare picture vanished. In its place was the vision—fair and bright, indeed, it seemed—of the end of the whole war in one or two violent shocks."

In the final analysis, the President made the only decision that was consistent with his duty to the nation and the soldiers whom he commanded.

Air Force readers will enjoy the account of Project Silver Plate, the code for AAF contributions to the early atomic program. The work began in July 1943 when General Groves requested General Arnold to conduct ballistic tests of the first weapon models.

From this the task expanded to include modification of a few B-29s to serve as atomic carriers, the organization of the 509th Composite Group in 1944 to serve as an atomic strike force, the careful training of its personnel, and the performance of the two atomic missions against Japan, known as Operation Centerboard. The treatment is sympathetic and makes easy reading but is disappointingly brief for the period between July 1943 and the summer of 1944.

About the reviewer: *Lee Bowen is presently employed in the Technological History Section, USAF Historical Division Liaison Office. He was Air Force historian for Operation Crossroads in 1946 and Operation Greenhouse in 1951, and was responsible for the preparation of a five-volume* History of the Air Force Atomic Energy Program.

Dynamism, Altruism, Patriotism

***The Professional Soldier*, by Morris Janowitz (Free Press, Glencoe, Ill., 1960, $6.75)**

Reviewed by Brig. Gen. Millard C. Young, USAF

Serious inquiry has finally been made into the private life span of the professional military leader as a member of a group. This inquiry has not left a cold, heroic piece of statuary or the memory of an adventuring opportunist to symbolize the type of person to whom we entrust our national security. Instead, it has portrayed a dynamic human figure, continuously in transit from one situation to another, motivated, in the main, by rather altruistic objectives.

While you could not get any one of our officers to agree with all of Janowitz' findings and conclusions, yet the great majority of these officers will admire the depth of inquiry of his study. The *esprit de corps* of each service will generate objections to certain things, ranging from the title of the book itself to what appears, at first, to be rather singular conclusions concerning each military department. Yet almost all of these conclusions have been expressed at one time or another by individuals as members of the services themselves, even within the particular subordinate organizations under discussion. Thus in many respects, Janowitz has been a chronicler of military viewpoints as well as an analyst in his own right.

Where the author has leveled a criticism—or, perhaps more properly stated, has recorded a criticism leveled against one group—it will also be found that earlier or later he has commended that same group for some other attitude or action. The balance sheet, on the whole, gives all services a good bill of health and gives many pats on the back. In other words, it leaves the service reader proud to belong to the military.

But perhaps the main attribute of the book is that it gives those who have little first-hand knowledge of the military a chance to scrutinize this category of fellow-citizens under clinical conditions. And that is good, because it shows the homogeneity of Americans within and without the service and contributes something to the strength of the military-civilian defense team.

The timeliness of this work is remarkable. It has been published at a moment in United States history when both discerning civilians and military men are asking many questions along the lines of the author's inquiries. At the significant sixth National Military-Industrial Conference (held in Chicago, Ill., April 25-27, 1960, under the auspices of the Institute for American Strategy), a number of the key conference managers and conferees were pleased to learn that *The Professional Soldier* was a prolific source of information for inquiry into such sub-

(Continued on following page)

jects as the so-called "constabulary concept" in outlooks for the military forces in the future; the degrees of involvement in political matters on the part of the military; the comparison of the new "managerial" type of service supervision with the more traditional forms and their present relative acceptance; the reputed ascendancy of the "absolutists" over the "pragmatists" in matters of strategy; the attitude of the services toward creative ability on the part of personnel; the relative promotional opportunities between conformists and individualists; and the comparison of motivation in military men and civilians.

The book is a monument to industrious research and correlation of facts, which resulted in a thoroughly dynamic presentation from start to finish.

In the July '60 issue of AIR FORCE, *on page 127, we published an unfavorable review of this book. While respecting a reviewer's right to his own opinion, we thought highly enough of* The Professional Soldier *to present the other side of the coin in this review by General Young, which appeared originally in* Science *magazine for June 1960 and appears here with special permission.*—THE EDITORS

It inquires into the historical development of myriad problems of management and control in relation to all facets of their environment as a means of assessing the present and the future military capabilities of the United States. Emphasis is given to personnel complexities and to the adaptability of the military as a whole, under the leadership of an elite group, to meet successfully the constantly changing situations of the present era.

The preface concludes that, "Despite its concern with managerial issues, the profession has been able to maintain its heroic posture, in varying degree, and its public service tradition. . . . Civilian control of military affairs remains intact and fundamentally acceptable to the military. . . ." From the military viewpoint it is believed that such conclusions are sound.

It is interesting to note the amount of attention Janowitz has devoted to ideological endeavors in the armed forces. In addition to his remarks, it might be said that there appears to be better receptivity to ideological considerations today than there was a few years ago and that this is attributable to the fact that the rank and file are now beginning to come to grips with the actual threat we are facing.

The author "speaks the language" of military strategy and tactics and of political warfare with professional ease. His discourses on the logic of war, on coalition warfare, and on total versus limited warfare, and political situations, complexions, and attitudes are extremely knowledgeable and interesting. He has uncovered many nuances in the attitudes and reasoning of his personalities and much fresh background information to substantiate his conclusions.

As a bonus effect, his portrayal of the social conflict attendant on the competition for admission into the elite leadership group (with its observance of service social customs and ceremonies) intrigues the ladies—from those seeking to marry into the service to the dowagers seeking to arrange "suitable matches." Young men will find it valuable for career planning purposes.

I consider the book to be a most important addition to my library.

About the reviewer: *General Young, a West Point graduate with twenty-nine years of commissioned service, is a member of the Secretary of the Air Force's Personnel Council.*

End of an Era?

In quick succession Arch Whitehouse has chronicled the two great wars in the air. His latest, *The Years of the War Birds: The Men and the Planes of World War II* (Doubleday, $4.95), shows again his skill at recreating those days of combat planes, raids and missions, and personal adventure.

The book contributes to the layman's literature of the great war. But the scholar, historian, and student of air science must look elsewhere for meaning, interpretation, cause, and result—the more serious aspects of air war.

The great air heroes of World War II come alive in combat sequences that honeycomb the book. The air ace is the star, while the bomber boys get a long salute. Historic air battles bring sober memories. Schweinfurt, Big-B, Bremen, Ploesti, Tokyo, and many others are recounted in terms of the men and the aircraft they flew, and their heroism and courage. There is descriptive treatment, too, of Allied and Axis combat aircraft.

Major emphasis is on the role and accomplishments of fighters and bombers over Europe and in the Pacific area. Other air activities receive lesser treatment. Elements such as troop carrier, air transport, and the fighter-bomber ground support play little or no part in the Whitehouse saga.

Some critics will disagree with the author's suggestion that World War II marks the end of manned military aircraft as an effective war weapon. Like the armored knight with lance and shield, aircraft now belong to history, claims Whitehouse. Technology has overtaken man; missiles, atomic warheads, nuclear surface ships, and missile submarines are the weapons of the future. ". . . the story we experienced in World War II . . . will never be repeated," he writes.

How then does he explain Korea and MIG Alley in terms of individual air combat and heroic exploits like those of Jabara, McConnell, Sebille, and others. Four Congressional Medal of Honor winners came out of the Korean War—the same as out of World War I air action. And, if Whitehouse is right, why all the effort *now* on X-15, Dyna-Soar, B-70, Project Mercury, and other aerospace craft emerging from the drawing boards. Man is still the indispensable item in the art of air war and a larger future is staked out for him in the indivisible realm of aerospace. Individual combat at 300,000 feet and up may indeed yield more heroism, courage, and skill than it did at 5,000 feet in World War I, 20,000 feet in World War II, or 40,000 feet and above in jets over Korea. The conquest of aerospace began at Kitty Hawk. We are not at the end of an era but progressing rapidly into it.

Aerospace Books

There are few books found in the literature of aerospace which provide a broad understanding of aviation and the influence it exerts on all human activity. James V. Bernardo's *Aviation in the Modern World: The Dramatic Impact Upon Our Lives of Aircraft, Missiles and Space Vehicles* (Dutton, $5.95) fills this need.

Bernardo's topics include a history of transportation from the stone age to the present; the influence of aviation upon geographical world concepts; development of air commerce; the general field of flying in five main categories—business, industrial, pleasure, air taxi, and training; air transportation and public welfare; the government role in aviation; the airport system. A large, thorough section is devoted to aviation in our defense effort, the exploration of space with manned and unmanned research and development programs. Bernardo re-

(*Continued on page 131*)

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lates his material to the social, economic, political, and moral patterns of our society.

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Aircraft Recognition Manual (AF Manual number 50-40) is an official Department of Defense guide and reference to current combat aircraft of major world air forces (including Soviet Russia). It presents in photo, three-view silhouette, narrative description, and table of operational and design specs, each fighter, bomber, transport, trainer, liaison, etc.

New revised edition of Patrick Moore's *A Guide to the Stars* (Norton, $4.95) gives the layman and amateur astronomer a highly readable, reliable reference.

Flight Facts for Private Pilots, by Merrill E. Tower (Aero Publishers, $3.50) covers theory and principles of flight, airplane operation, use of instruments, meteorology, navigation, and safe flight practices. Excellent for student and private pilots.

The younger set especially will want Capt. Keith Laumer's *How to Design and Build Flying Models* (Harper, $4.95). This "do it yourself" is a comprehensive text/reference containing clear drawings and full instructions on all phases of model building from simple gliders to elaborate engine models. Among other items, it covers designing your own craft from original ideas, getting the model aloft, constructing free-flight and control-line types, and the trick of rebuilding a wreck.

AFA'er Clive E. Davis has come up with another gem for the young adult, but of interest to all ages. *Man and Space* (Dodd, Mead, $2.75) is a well illustrated general treatment of what we know about earth and space, what our military space programs are doing, and how we are preparing man for spaceflight. Other topics include space probes to date and the relationship of the space age to the individual. A glossary of aerospace terms is included.

Hank Searls's latest thriller, bound for moviedom, is a novel involving commercial airliners and military aircraft on the east-west airways. In *The Crowded Sky* (Harper, $3.95), airman Searls probes deep into the minds, action, judgments, and thoughts of pilots cruising along heavily trafficked, controlled airways in a night heavy-weather situation. Radio communications alone is the thread to safety, and it is not infallible. Such ingredients make a suspenseful plot.

—MAJ. JAMES F. SUNDERMAN

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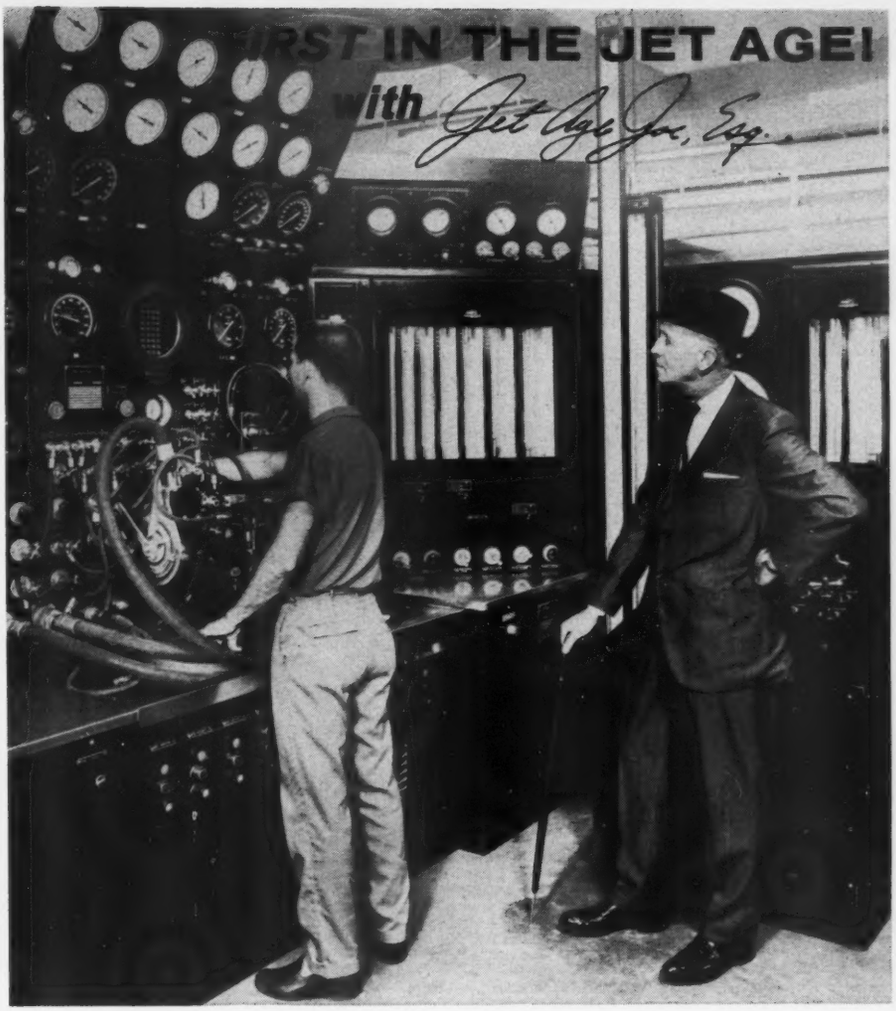

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